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U. S. DEPARTMENT OF AGRICULTURE.

Report No. 90.

PROGRESS

OF THE

BEET-SUGAR INDUSTRY

IN

THE UNITED STATES

IN

1908.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1909.

[Public Resolution No. 51.]

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That there be printed twelve thousand copies of the report on the progress of the beet-sugar industry in the United States in nineteen hundred and five; one thousand copies for the use of the Senate, three thousand copies for the use of the House of Representatives, and eight thousand copies for the use of the Department of Agriculture, and that the Secretary of Agriculture be authorized to print and distribute annually hereafter eight thousand copies of such annual reports covering the progress of the beet-sugar industry: *Provided*, That the preparation and publication of such annual reports shall be within the discretion of the Secretary of Agriculture.

Approved, June 30, 1906.

LETTER OF TRANSMITTAL.

U. S. Department of Agriculture,
Bureau of Plant Industry,
Office of Chief of Bureau,
Washington, D. C., May 1, 1909.

Sir: I transmit herewith for your approval the manuscript of the annual report on Progress of the Beet-Sugar Industry in the United States in 1908, as prepared by Mr. Charles F. Saylor, a special agent of the Department.

Respectfully,

B. T. Galloway,
Chief of Bureau.

Hon. James Wilson,
Secretary.

CONTENTS.

PROGRESS OF THE BEET-SUGAR INDUSTRY IN THE UNITED STATES IN 1908.

By Charles F. Saylor,
Special Agent.

LETTER OF SUBMITTAL.

U. S. Department of Agriculture,
Washington, D. C., March 25, 1909.

Sir: I submit herewith for your inspection and approval my twelfth annual report on the Progress of the Beet-Sugar Industry in the United States. It contains a general review of the needs and prospects of the industry, reports on conditions and results achieved on the farms and in the factories, a report on the disposal and uses of factory by-products, and the usual statistical matter.

Respectfully,

Charles F. Saylor,
Special Agent.

Dr. B. T. Galloway,
Chief Bureau of Plant Industry.

INTRODUCTION.

In my twelfth annual report on the Progress of the Beet-Sugar Industry I am not able to report as great a production of sugar as in 1907. There are, however, many things to indicate the industry's stability.

Considering the whole country, climatic conditions have not been normal. Unfavorable weather occurred during the planting season in nearly all the different beet-growing areas. In some places there were excessive rains; in others the weather was too cold or too dry. In most of the States, Colorado particularly excepted, fairly favorable weather conditions existed during the growing season. There would, however, have been a larger planted and harvested area throughout the United States had it not been for the unfavorable weather conditions of the planting period. In many places the yield and quality of beets were good. The total output of beets and sugar was reduced on account of the smaller area planted.

It is quite a common belief that the sugar industry is better adapted to irrigation districts, like those of Colorado, Utah, Idaho, and Montana, than to the humid areas farther east. In this connection I call attention to the State of Michigan, where the beet crop is entirely dependent upon rainfall. The averages for the beets grown in the State during the past year are as follows:

Sugar in beets	per cent	17.1
Purity coefficient		84.8
Tonnage per acre		7.54

Excepting the low yield per acre these are very satisfactory figures. Barring the effects of unfavorable weather on acreage and yield, beets made a splendid record in Michigan in 1908.

Colorado has been considered the leading State in the production of beet sugar. The beet crop there is dependent upon irrigation. The averages of this State for the year were:

Yield per acre	tons	9.28
Sugar contents	per cent	13.85
Purity coefficient		81.80

While the yield was greater than in the State of Michigan, in the latter State more sugar was produced per acre and probably at a less cost.

One of the important features of this report is the data presented concerning the uses made of by-products of the sugar factories. The rapid development we have made in this direction is surprising. The factories of New York and Ohio and those Wisconsin factories which are in districts having well-developed dairy and stock-feeding interests have always been able to dispose of their pulp. The dairymen of those States, who were accustomed to feeding by-products of the distilleries, breweries, starch factories, etc., at once recognized the value of the sugar factory. They bought the pulp and molasses and paid higher prices for them than in other parts of the country.

Factory districts in California, Colorado, and Utah began at once to increase the breeding, feeding, dairying, and creamery interests in order to take advantage of the by-products of the sugar factories. It necessarily took time to develop these interests sufficiently to consume these by-products at a price commensurate with their value. In factory districts like those of Michigan, Illinois, Iowa, Nebraska, and Minnesota, where all kinds of grain and forage are grown, the people have been slower to recognize the value and take up the use of the beet pulp.

An important developmental feature is the installation in many factories of drying plants for preparing a stock food that may be shipped any distance. In some cases molasses is mixed with the pulp. There are now 11 factories in this country having pulp-drying plants.

In Germany and France most of the pulp coming from the factories is prepared in this manner, and placed on the market for general use in feeding stock. Present developments in this country indicate that in the near future the entire amount of pulp produced will be used as feed for stock.

Only one new factory was installed last year, but the factories already in operation are constantly making improvements, introducing new methods, installing improved machinery, and increasing their facilities. They have not only directly contributed to the progress of the industry, but their presence, with that of allied interests, has prompted the building of railroads and trolley lines and stimulated many other improvements. These improvements may be considered as much a part of the development of the beet-sugar industry as the installation of new factories.

It will be noticed that in many new places in the country organizations have been formed to establish additional factories at an opportune time. But several things have operated to cause hesitancy. The recent money stringency materially retarded the development of new projects; the prospective change of administration and uncertainty concerning legislative policies have been constantly in evidence for some time. These things have temporarily retarded the building of new beet-sugar plants.

Considering the high wages and the high ideals maintained in this country, it is natural for the ordinary thinker to conceive that we are handicapped in the production of a world-wide product like sugar. But there are important factors in our favor, among which are the following:

Our great consumption of sugar makes this country a great market for this product. If this industry should continue to share in an ordinary degree the favor that has been extended to many of our other great industries, it will be able to maintain itself until all obstacles affecting it are overcome. Our competitors are Cuba and other tropical countries, which produce cane sugar, and Germany, France, and other countries of Europe, which produce sugar from beets.

Our laboring classes are characterized by intelligence and industry, which enables us to effect the greatest results at the cheapest cost. Americans have an experimental, investigative turn of mind, and willingness to spend money and energy in perfecting machinery and processes to produce the best at the least expenditure.

In Cuba, Germany, France, and other countries that produce sugar for our markets (and this is especially true of European countries) we find set ideas. In this country we combine the best ideas of all, especially of the countries of Europe, with our own. We employ in our industry the German, Frenchman, Austrian, Swede, Russian, Hollander, Mexican, Japanese, Chinaman, and to some

extent other peoples knowing more or less about the production of sugar. In this we blend the hustling, progressive spirit of the American with the stolid, tenacious industry of the German and the plodding, laborious industry of the laborer from southern Europe, Japan, Mexico, etc. I contend that we are fortunate that we do not have at this time a fixed national type. We get the combined wisdom and effort of all. Especially in this industry do we have a restless disposition to develop things not known. This naturally leads us to the highest type of investigation and experimentation.

These are things peculiarly a part of the sugar industry. In no other line of agricultural progress have investigation and experiment proceeded so far and so fast in connection with the development of a great industry.

Every factory in this country, in its laboratory and in the fields surrounding it, engages in experiments and investigations. Our State experiment stations and agricultural colleges carry on investigations and experiments helpful to the development of this industry. From New York to California the inventive American genius is working to perfect methods, implements, and machinery for producing sugar.

Our future in sugar production must depend on our agricultural progress and the laws and conditions governing our trade relations. We must overcome the lower wage scale and cheaper production of other countries. At the present time we should aim chiefly to supply our home market; after that commercial conditions will decide whether we can reach outside or not. This is a great field. The sugar industry in this country has proceeded very rapidly, but has not nearly kept pace with increased consumption of sugar.

On the whole, conditions are favorable and indications are assuring for the further rapid development of the beet-sugar industry.

LINES OF FUTURE PROGRESS.

Among the things at which we should continually aim in this country are the following: (1) The production of the largest tonnage of beets; (2) the production of beets of highest quality and purity; (3) the commercial consumption of all by-products of the beet-sugar factories; (4) the production of the highest quality of beet seed; (5) the best methods of sugar-beet culture and soil management; (6) the production and use of the best implements for preparing the seed bed and cultivating and harvesting the beets; (7) the use in the factories of the most economical processes and the most effective machinery.

We must accomplish many other things which are secondary, though of high importance, as for instance: (1) The best rotation of

crops with sugar beets; (2) the fertilization of different soils for best results; (3) the proper drainage for reclaiming and maintaining soils; (4) the improvement of transportation facilities; (5) bringing the feeder, the farmer, the dairyman, the creameryman, and the breeder into closer touch as beneficiaries of this great industry.

The following is a brief discussion of some of the lines of improvement just enumerated:

PRODUCTION OF THE LARGEST TONNAGE.

As shown in my reports, the average tonnage of beets produced in the United States since 1900 has been as follows:

Average tonnage per acre of beets produced in the United States, 1901–1908.

	Tons.		Tons.
1901	9.63	1905	8.67
1902	8.76	1906	11.26
1903	8.56	1907	10.16
1904	10.47	1908	9.36

In Germany—one of the oldest and best-developed beet-producing countries—the average yield of beets per acre is about 13 tons. In districts where beets are the main crop they have been produced in Germany for nearly a century. The beet producers of Germany follow scientific methods in rotation of crops. They do not grow beets year after year on the same lands, although beets are the main crop. Every acre of land enters into a systematic plan of rotation, in which beets enter at the proper time, and all the crops grown in the rotation contribute to the mechanical condition and preparation of the soil. A crop is selected to precede the beets that leaves land in the best condition for producing beets. Fertilizers are also applied systematically.

What is true of Germany is also true to a greater or less extent of all older beet-growing districts in other European countries. On the other hand, American beet producers have so far depended more or less largely on the natural fertility of the soil. But experiments have demonstrated that, if intensive methods are applied even in a lesser degree, we can grow a higher tonnage of beets in this country than they do in those older countries with their strictly scientific culture.

In the older beet-growing districts of the United States a beginning has been made in the introduction of intensive methods, and our tonnage is gradually increasing. The installation of new factories constantly tends, on the other hand, to diminish our average tonnage. But enough is being accomplished in the older beet-growing areas and by experimentation to demonstrate that this country is entitled to a very much larger tonnage.

An acre of beets with rows 18 inches apart and beets 8 inches apart in the row, if the average weight of the beets is 2 pounds, will yield about 43 tons. There is a vast difference between 9 or 10 tons per acre and 43 tons. Taking the average yield, at the average price of beets—about $5.50 per ton—we find that the average gross receipts per acre are about $49.50. The ideal production, 43 tons per acre, at $5.50 per ton, would amount to $236.50.

It must not be presumed that we can reach the ideal, but it is the business of the investigator and experimenter to gradually lessen the distance between extremes of our present average production and the limits of possibilities. I must insist that we are entitled to a considerably larger tonnage with ordinary experience and a better knowledge of methods of culture. When we demonstrate, as the older countries have done, the advantages of rotation, fertilization, and the best methods of culture we will be entitled to much more.

It takes about 6 tons of beets per acre at the usual price to meet the expense of producing an acre of beets. All tonnage over this is profit to the farmer. Without profit the farmer will not continue growing beets and supplying the sugar factories. It is evident, therefore, that the tonnage per acre is one of the principal factors on which depend the future growth and prosperity of the beet-sugar industry in this country.

While it must be evident that the financial returns of the sugar-beet grower depend mainly on the tonnage, he derives other benefits. The culture needed by this crop contributes very much to the improvement of his farm and the preparation of his land for growing other crops. The fertilization and drainage improve land for general farming. The sugar-beet crop leaves the field with a soil thoroughly pulverized, and to greater depths than ordinarily, and comparatively free from weed and grass seed. The farmer is taught the lesson of intensive farming. He is practically forced into rotation and fertilization of his lands. He consults the experiment station, studies methods, and introduces improved implements.

PRODUCTION OF BEETS OF HIGHEST QUALITY AND PURITY.

Investigation and experimentation have also been energetically directed to producing beets of higher quality. When the beet-sugar industry began in Europe the sugar contents of beets were very much lower than now. They averaged about 6 or 7 per cent. The purity was also low. Continued investigation and experimentation, together with systematic plant breeding, have very much improved the average sugar contents. We have factories in this country that have run entire campaigns with beets averaging 19 per cent of sugar and with an average coefficient of purity exceeding 84. This question of quality is as important to the factory as tonnage is to the farmer.

When the factory buys a ton of beets, the main purpose is to buy the sugar contents. It is evident that beets containing 19 per cent of sugar are worth much more to the factory than beets containing only 12 per cent (the minimum percentage acceptable to the factory). It is also important that the purity shall be high. By purity we mean freedom from other solids generally found in the beet. Among these solids are salts of various kinds which interfere with the process of extracting the sugar. Under the best processes of extracting sugar from beets something like one-sixth of the sugar passes off with the refuse. This is partly due to the interference of these salts in the process of extracting sugar. Every factory demands not only beets with high sugar contents, but also those with high purity.

It is very evident that the quality of the beets is a subject in which the factories are vitally interested. The farmer is also largely interested, because the factory can afford to pay more for beets containing the maximum of sugar than for those with the minimum or even anything below the maximum. In fact, the factory and the farmer are mutually concerned in both the tonnage and quality. The factory desires a sufficient supply of beets, such as results from a large tonnage per acre on a sufficient acreage: and this in turn encourages the farmer and other farmers to continue to grow the crop. Beet growers will not continue in the business unless the receipts for the crop compare favorably with those for other crops. The farmer is interested in the quality of beets, because it encourages the factory and enables it to pay a higher price. The interests of the factory and of the farmer are not antagonistic, but to a large extent identical.

We are rapidly improving the quality of the beets. It is now quite common for factory districts to secure an average sugar content of 15 or 16 per cent for an entire crop, with an average purity of 80 to 85. When the sugar industry began in this country, such results were looked upon as ideal. General averages throughout the country are held down, the same as with tonnage, by the introduction of new lands cultivated by inexperienced farmers as the industry reaches out into new territory.

INCREASED USE OF BY-PRODUCTS.

In the production of sugar from beets we are turning out large quantities of pulp, waste molasses, and lime. The first is the residue of the beet after the sugar is extracted: the second is the residue of the sirup after all the sugar possible has been crystallized; the third is the waste product resulting from the use of lime in clarifying and purifying the juice.

The pulp contains a small residue of sugar and the vegetable structure of the beet plants. In older beet-growing countries this pulp is considered an important product. It is highly valued as

animal food. It may be used in the fresh state direct from the factory, or it may be dried, put up in packages, and shipped to all parts of the country. In the process of drying, waste molasses is often mixed with the pulp, the mixture being put through specially constructed drying kilns.

Some of our principal industries in this country, such as meat packing, depend largely for their profits on the sale of by-products. In European countries the same may be said of the beet-sugar industry.

Out of the 64 plants in the United States 11 have installed special kilns, or plants, for preparing dried pulp. A majority of the remaining factories are able to dispose of the wet pulp direct from the factory at figures ranging from 10 cents to 75 cents per ton. At a number of factories the pulp is given to the beet growers. A few factories deposit the pulp in low places, or get rid of it the easiest way to prevent its becoming a nuisance. This condition of pulp consumption is largely due to the fact that farmers and feeders do not understand its value as stock food. It takes time to educate these people to an appreciation of the value of this by-product as a food for their animals. Its consumption is gradually increasing; in the end there is no doubt that feeders of this country will demand it as they do in the older countries. Many more of our factories will eventually dry their pulp and ship it to the natural markets for consumption. the same as they do their main product—sugar. It is evident that until such a time arrives the factory is not working at its best advantage.

PRODUCTION OF HIGH QUALITY BEET SEED.

One of the principal things upon which a farm crop is dependent is the quality of the seed. Quality in this sense means vitality, and power to reproduce the sugar-bearing tendency of the mother beet.

The production of beet seed is a very complex and time-consuming business. Properly conducted, it requires extensive capital and years of laborious work in its upbuilding. In the production of high-grade seed large laboratories and much patient labor are necessary. It takes years to put a business of this kind on a footing as a successful commercial enterprise. Farmers of this country are apt to assume that beet seed is produced like the ordinary vegetable seeds which they may grow in their own gardens and fields. In the production of beet seed on a large scale a reliable concern requires as much capital as is necessary to establish a sugar factory. After the business is established it requires years to build up a trade and a reputation for furnishing fresh seed of high quality.

Purchase of foreign-grown seed.—One of the main troubles with the factories in this country has been the lack of knowledge concerning the best source from which to draw the seed used in growing beets for their use. They have depended on European countries—mainly France and Germany—for the supply. There were many reliable firms; there were others, not really producers of beet seed, but assemblers or brokers, who gathered this seed from unknown sources, established agencies in this country, and sold us beet seed. In many instances this seed was guaranteed; in some cases it was satisfactory, but in many others it proved inferior, and its use proved detrimental to the industry in this country. Of course, factory people have acquired a much better knowledge through practical experience in buying their seed of foreigners, but still it must be apparent that the seed production should be a home enterprise and go hand in hand with beet-sugar production.

Home production of seed.—Through experimentation we are gradually entering this field. To a limited extent the following companies are growing beet seed at considerable expense: The Utah-Idaho Sugar Company in Utah; American Beet Sugar Company at Oxnard, Cal.; the Michigan Sugar Company and a few others in Michigan. Mr. Edgar H. Morrison, a private seed grower at Fairfield, Wash., has been producing a considerable amount of beet seed of high quality and vitality.

While the beet seed grown in this country is only sufficient in amount to meet a small part of our needs, enough has been done to demonstrate that we can very much improve the vitality and quality of seed by producing it at home. All the efforts to produce beet seed in this country have so far been largely experimental.

Single-germ seed.—The United States Department of Agriculture is conducting experiments, in connection with the State experiment stations and beet-sugar factories, to develop better seed. One of the chief objects of these experiments is the production of a strain of beets bearing single-germ seed balls. A beet seed ball—commonly spoken of as a "beet seed"—has from one to six germs or seeds, and from this fact results much of the expense and trouble of beet culture. In order to secure a stand of beets, it is necessary to plant from 15 to 20 pounds of seed per acre. The seed balls are sown in a row from one-half to an inch apart. When the plantlets come through the ground, all beets not necessary to a perfect stand must be removed. A hoe is used to cut out all the plants except a bunch every 8 inches. This work is known as "bunching." After the beets are "bunched" a workman must crawl along on his hands and knees and remove all the surplus beets in each bunch, leaving one. This "thinning" requires a good deal of time and necessitates considerable expense. It should be the aim of the thinner to remove all plants in the bunch

except the most healthy one. Of course not a great deal of time can be given to the selection of a particular plant in a bunch. Quick action of the hand and eye is required. Presuming that the selected plantlet is the outgrowth of a beet ball with six germs, all sprouted, we naturally have a condition in which this plant may be intertwined with several others. In removing the surplus plants the thinner disturbs more or less seriously the one that is to remain. He breaks its rootlets to considerable extent and loosens it in the soil, thus retarding its growth. It takes a week or more for the plants to recover from this process of thinning.

If a strain of beets bearing single-germ seed balls can be produced, several advantages will be gained:

First. A single plantlet will draw nourishment from the beet ball instead of several.

Second. It will not be necessary to disturb the growth of the plantlet in the process of thinning.

Third. The plants which are to remain in the ground can be selected and all the others cut out with the hoe, thereby eliminating the cost and trouble of thinning.

Fourth. The first few weeks of a beet plant's growth constitute its tender stage. If we can produce a single-germ plant, which need not be disturbed in thinning, the plant will thrive better from the beginning, and it will be better able to withstand the crusting of the ground through beating rains and to contend with grass and weeds.

The Department of Agriculture has conducted experiments covering several years with a view to producing this single-germ beet ball. The work began by selecting for planting single-germ beet balls. The beets grown from these seeds were used as mothers for producing another crop of beet seed, from which the single-germ balls were selected for planting, and so on. This work has been carried on under supervision of the Chief of the Bureau of Plant Industry, and reports of progress have been made from time to time. An experiment of this kind requires time. The experiment is very interesting in the promise it offers for future improvement of the beet plant.

METHODS OF CULTIVATION AND SOIL MANAGEMENT.

Conditions in the old highly cultivated fields of Europe are very dissimilar to those prevailing in this country. In European countries beet growing or any kind of farming must depend upon the application of the strictest scientific principles and the closest economy. In this country, especially in the newer portions, we have been simply harvesting returns from the virgin soil. The future must eventually bring us to the same conditions as those prevailing in the beet-growing countries of Europe. The sooner we realize this, the better for us.

Even in our older States we have scarcely begun to give that careful, systematic attention to details which European farmers must give. We are growing sugar beets under many conditions of soil and climate. In New York, Ohio, Michigan, Wisconsin, Illinois, and Minnesota the chief difficulty lies in excessive rainfall at planting and harvest. In such States we are particularly concerned about drainage. In Colorado, Utah, Montana, Idaho, California, and other Western States the beet growers are principally interested in securing sufficient water to irrigate their crops. In our Eastern and Central States we have an alluvial soil, naturally well supplied with humus. In our Western States we have a silt soil, containing an abundance of the mineral elements necessary for plant food, but lacking in humus. This must be supplied by some method of fertilization, such as the application of barnyard manure or green manuring.

Different soils require different methods of cultivation. Some soils require deep plowing, others do not; some require subsoiling, with others this is not necessary.

Work of the factory agriculturist.—Every sugar factory has an officer usually known as an "agriculturist," whose duty it is to look after the agricultural side of the factory's interests. This man should be a thoroughly trained scientist in agriculture. He should understand the requirements and methods of general farming. Of course, his specialty is the sugar-beet crop. Working under him are several assistants, who should be well qualified for the work they have to do. The agriculturist and his assistants are moving over the beet-growing districts every day during the growing season, coming in contact with the farmers and advising them in the performance of the work. The next year they may have to deal considerably with another set of farmers, but they keep in touch all the time with the old set. They keep track of all farmers who are likely to grow beets in the near future. They help arrange rotations, suggest methods of fertilization, and development of conditions.

Gradually in the course of a rotation cycle a large scope of country adjacent to the sugar factory, with its farmers, has fallen under the influence of this corps of scientific, practical men. It is plain to be seen that as the years roll by conditions must be improved in such a district. The farmers become better informed and more experienced and the younger generation growing up falls heir to these advantages. It is in a sense an "extension course" in agriculture, with the farmers as the students and their fields as laboratories.

Fertilization of the soil.—Fertilization depends upon the character of the soil. Different soils lack different ingredients. What is lacking must be supplied. Some require humus, some nitrogen, potash, or phosphoric acid. These can be readily supplied to greater or less

extent by the application of barnyard manure, and by growing and plowing under green crops. Some soils need applications of commercial fertilizers. Some soils require a dissolvent to make available the plant food which they contain. It is idle to talk about fertilizing land unless what is needed is thoroughly understood. There is nothing that requires more intelligent action for successful results than fertilization.

I hesitate to offer specific recommendations with reference to this matter. Barnyard manures and plowing under green crops are generally beneficial if applied a year or two in advance of the beet crop.

Every beet grower is or should be in touch with his State experiment station and the United States Department of Agriculture, and he has the agriculturist of the factory, with whom he can advise on these points. The best suggestion I can make is to advise all beet growers to draw from these sources of information.

Every well-planned rotation should provide for one or more leguminous crops, such as clover, alfalfa, cowpeas, field peas, etc. By the growth of these our lands are reinforced by the storage in the soil of nitrogen from the atmosphere and by plowing under green crops.

Experiments in this country during the past few years have had a great influence in opening the eyes of the farmers to the necessity for and the value of fertilization. The younger generations growing up in the atmosphere of these experiments, through reading agricultural publications, and attending farmers' institutes, will be much more alive to the importance of fertilization.

In Bulletin 166, Cornell University, Ithaca, N. Y., are given the results of a very exhaustive experiment on the effect of fertilizers upon yield and quality of beets. The following are quotations from this bulletin:

EFFECT OF FERTILIZER UPON YIELD.

The station supplied sacks of fertilizer to a number of farmers to be applied to a part of their experimental area. The sacks contained—

Fifty-eight pounds of dissolved rock, guaranteed 14 per cent phosphoric acid;

Forty pounds of sulphate of potash, guaranteed 50 per cent potash;

Thirty pounds of sulphate of ammonia, guaranteed 20 per cent nitrogen.

Each lot of fertilizer was intended for a one-fourth acre plat, or at the rate of 512 pounds of the mixture per acre, furnishing 24 pounds of nitrogen, 32½ pounds of phosphoric acid, and 80 pounds of potash. While the effect of the fertilizer was very apparent during the growing period, producing a much more vigorous growth and in several instances resulting in a much better stand of plants, yet it is greatly to be regretted that only five growers took pains to harvest the fertilized and unfertilized plats separately so as to be able to report comparative yields. Some of these grew several varieties of beets, so that reports on yield included 13 plats fertilized and 13 plats unfertilized, and the reports on analyses of beets include 20 plats fertilized and an equal number unfertilized. The average yield of the fertilized plats reported was 12.84 tons per acre and of the unfertilized 9.37 tons—a gain of 3.47 tons per acre in favor

of the fertilized plats. In some instances the gain was very much more marked than in others and was profitably secured. On the average the gain just about paid the cost of the fertilizer and the labor of handling the extra tonnage of beets. In the second and third columns of the following table are given the respective yields obtained from the fertilized and unfertilized plats:

Influence of fertilizer upon yield and quality of beets.

Grower.	Number of varieties averaged.	Yield per acre.		Sugar in beets.		Purity coefficient.	
		Fertilized.	Not fertilized.	Fertilized.	Not fertilized.	Fertilized.	Not fertilized.
		Tons.	*Tons.*	*Per cent.*	*Per cent.*		
D. H. McLallen, Trumansburg.	4	10.95	7.59	15.31	14.51	84.4	82.7
C. E. Chapman, Peruville	3	18.61	11.81	16.98	15.03	86.7	83.3
C. D. Cartwright, Darien	3	12.43	10.17	17.50	16.59	86.1	86.5
L. R. Rogers, Albion	2	10.43	7.03	16.77	16.34	88.8	88.0
F. R. Thompson, Westfield	1	11.80	10.25	16.15	15.06	89.9	88.5
C. B. Kershaw, Owego	1	.....	.....	11.40	11.59	76.4	79.2
C. D. Jaekson, Peruville	1	.....	.....	14.44	14.16	83.0	79.4
J. C. Murphy, Horseheads	4	.....	.....	13.23	14.42	81.0	84.1
A. J. Howland, Ithaca	1	.....	.....	15.77	15.25	80.2	81.5
Averages	.....	12.84	9.37	15.28	14.74	84.0	83.7
Gains on fertilized plats	.....	3.47	.....	.54	.....	.3	.....

The table given above shows the effect produced by the fertilizer described under the last topic upon the per cent of sugar in the beets and the purity of the juice. Nine experiments gave 20 plats fertilized by the side of 20 plats unfertilized. The average per cent of sugar in the beets produced on the former was 15.28 and on the latter 14.74, a difference of 0.54 in favor of the fertilized plats. The average purity of the juice obtained from the former was 84 and from the latter 83.7, a difference of 0.3 in favor of the fertilized plats.

Rotation of crops.—As a general proposition, no crop should be grown continuously on the same land. Rotation is absolutely necessary in the production of sugar beets.

Beets may be rotated with almost any of the field crops grown in this country, as clover, alfalfa, field peas, barley, rye, wheat, oats, spelt, corn, or potatoes. The crops should be selected and the rotation arranged so as to secure the best returns and at the same time leave the ground in the best shape for growing sugar beets.

Drainage.—Throughout the Mississippi Valley drainage is largely a matter of removing surplus moisture. This is usually accomplished by tiling. In many of our Eastern States where beets are grown, as in parts of Michigan and Ohio, tile drainage is not sufficient. When heavy precipitation occurs in the hot months, like July, the water is liable to stand on the surface. If it is allowed to remain on the ground during hot weather the beet plants standing in water will be destroyed—"cooked," as the farmers say. In such cases it has been considered good practice to lay off the fields in "lands" from 30 to 40 feet wide, with dead furrows between, running in the direction of the natural drainage. These furrows should connect with open

drains which carry the water off into low places or streams. By such a method the surface water can be removed without delay. Where water is liable to stand on fields, tiling is usually placed nearer the surface, say not over 2 feet deep.

Where alfalfa is grown, tile drains are liable to be closed up by the roots of the plants entering the channel of drainage at the joints. This plan of surface drainage through dead furrows serves to relieve this condition to some extent. These furrows remove the surface water immediately, and allow the tile drains to be placed at greater depths so as to be freer from plant roots. The clay loam soils of some of the Eastern States, particularly Ohio and Michigan, prevent such quick seepage of the water from the surface as occurs in the case of the sandy loams of Iowa, Illinois, Nebraska, and Minnesota, where tiling placed from 3 to 4 feet deep usually drains wet lands satisfactorily.

Drainage in most western districts is largely for the purpose of removing the surplus water applied to the lands by irrigation. These lands in many instances contain large deposits of alkali. When such lands are cultivated under irrigation, capillary attraction tends to bring this alkali to the surface. In quantities, it is detrimental to plant growth; sugar beets resist alkali better than most cultivated field plants, but an excess of it is detrimental even to sugar beets. In such cases a good tile drainage system is necessary. With the surplus water the drains carry off the alkali in solution. Gradually the fields may be improved in this way and in time may recover their original usefulness. Tile drainage also assists in the aeration of the soil.

Sugar beets send down their taproots to considerable depths. When the beets are harvested, the taproot is broken off and remains in the soil with its thread-like laterals. These decay, leaving perforations in the subsoil and lower strata, which aid during a dry season in bringing up moisture.

Preparing the land.—The most practical methods of surface cultivation are those best adapted to the particular soil in question.

Fields selected for growing sugar beets should, if possible, be plowed some time prior to the planting of the seed. In districts where there is hard freezing, the heaving and pulverizing which result are beneficial to the soil. Early plowing gives a chance for the germination and growth of grass and weeds, which may be destroyed by going over the surface with the cultivator and harrow.

The surface of the seed bed should be cultivated and harrowed regularly up to the time of planting. This is good practice everywhere on lands where beets are grown in this country. The original plowing as a rule should be at greater depths than for other crops. Where the land has not been plowed deep before, as a rule the depth

should be gradually increased. It may be plowed an inch to an inch and a half deeper each season until the maximum is reached.

In many cases the action of the soil is very much improved by subsoiling. This does not have the detrimental effect sometimes produced by deep plowing; it does not turn up to the surface soil that has not been in use, but loosens the subsoil to greater depths. The difficulty with plowing soil too deep is that it turns under soil that is in the best condition for plant growth, and throws on top considerable soil that has not been turned up before and is not prepared for plant growth.

It is a good plan to have beets follow clover, alfalfa, or some other leguminous crop; or they may follow small grain to advantage. Corn fields also make good beet land, except that the removal of the stubs and stalks is more or less troublesome and expensive. The fact that the corn ground has been cultivated the year before is a factor in its favor, but it is absolutely necessary to remove the stalks and stubs as they interfere seriously with the cultivation of the beets if they are plowed under.

The matter which follows I have taken from a bulletin[a] of the Michigan agricultural experiment station.

In this State more sugar factories have been built than in any other. The directions and suggestions given apply specifically to Michigan, but they will doubtless prove of value to growers in many other States.

Soil and climate.—It has been pretty well demonstrated that the climate and soil of the Lower Peninsula of Michigan are well adapted to the growth of beets containing a high percentage of sugar. All soils in the State, as far as tested, have proven of the right quality for this crop, except stiff clays and black swamp muck. Any soil, with these exceptions, that will produce a good crop of corn or potatoes, will, with proper cultivation, produce a profitable crop of sugar beets. Sandy loams, because naturally porous, head the list of most available soils.

If the subsoil is hard and relatively impenetrable by the desired long taproot of the beet, it must be broken up by the subsoil plow to a depth of at least a foot, and better, 18 inches. A layer of soft, mellow soil of this depth must be provided either by nature or by the use of the subsoil plow. Natural fertility is required to produce the largest yield. If it is wanting the attempt must not be made to supply it by plowing under coarse manure just prior to sowing the beet seed. It has been found, in such cases, that the beets, instead of growing with long, smooth, conical taproots, tend to be branching and irregular in shape, a fault that injures them materially in the estimation of the factory. The manure should be applied at least a year previous to sowing the beet seed. A rotation of crops is thus required. A four-year rotation is probably better than a three-year, although no definite experiments have been made on this point. Beets should follow wheat or some other cereal which will allow plowing in the fall, and, if subsoiling is needed, it should be done at that time. The

[a] Special Bulletin No. 10, Michigan State Experiment Station, Clinton D. Smith, director; R. C. Kedzie, chemist.

rotation must be adapted to the character of the soil. If the loam tends toward clay, a hoed crop—such as corn or potatoes—should be interposed between two crops of beets. Manure should be applied to the crop immediately preceding the beets or to the one two years before, thus insuring its thorough incorporation with the soil.

The use of commercial fertilizers is by all means to be commended for this crop. Select those furnishing the nitrogen from mineral sources, either as nitrate of soda or in some similar immediately soluble and available form. Fertilizers rich in phosphoric acid and furnishing a large amount of potash are also valuable. Apply the nitrogenous manures broadcast after the beet seed is sown and prior to the first cultivation.

Preparation of the ground.—On clay loam the plowing should be done in the fall. The subsoiling also should, as far as possible, be done in the fall. Where the soil is a sandy loam verging toward clear sand, the plowing may be deferred until spring, still using the subsoil plow where needed. Whether the ground be plowed in the fall or spring, it must be made fine and mellow by frequent harrowing. The roller is used in a dry season only on either sandy or lumpy ground. It is discarded entirely on wet land or upon soils containing much clay. If the roller is used a harrow should follow immediately to prevent the escape of moisture. Make the top of the soil as nearly level as possible. Do not sow the seed until the soil is in the condition of an ideal garden. If rain threatens, it is wise to postpone putting in the seed until a shower shall have germinated the weed seeds, then the young plants may be killed by a smoothing harrow, thus saving part of the labor of weeding by hand later.

As soon as the temperature of the soil reaches 50° F., and certainly by the middle of May, the seed should be planted. Beet seed germinates at a much lower temperature than corn, and the young beet plants are not injured by a light frost. It is wise to plant early and to apply quick-acting fertilizers, in order that the young beets may secure a firm hold on the soil, with a long taproot, before dry weather sets in.

Seed.—To secure a profitable yield of sugar it is necessary to use selected seed grown from selected mother beets. Modern sugar beets are abnormally rich in sugar. This unnatural sweetness is secured alone by selecting, generation after generation, the richest beets for the production of seed. Beets grown from seed produced by sugar beets grown in the ordinary way, without proper selection, are certain to be low in sugar content. Sow no seed not obtained from growers of repute. Because seed is imported it does not follow that it is either of the best variety or grown with suitable precautions.

Planting and cultivation.—After the soil has been brought into perfect condition as to tilth and depth, sow the beet seed, using a hand drill for small areas or a four-row beet drill where the crop is grown for the factory. Make the rows as nearly straight as possible for convenience and cultivation. The rows should be 18, 20, or 22 inches apart. If you have cultivators built expressly for the purpose have the rows as near together as 18 inches; if you must use the ordinary corn cultivators keep the rows farther apart, regulating the distance by the width of your cultivator.

Sow from 12 to 15 pounds of seed per acre. This amount of seed seems excessive, but it is required to insure a perfect stand. Start the cultivator as soon as the rows are plainly visible and go through the beets frequently thereafter to kill the weeds and to secure the soil mulch necessary to conserve the moisture. The use of wheel hoes to kill the weeds close to the rows both while the beets are young and later, just before thinning, is commended by experience. Thorough tillage should be continued after the beets are thinned up to the time

when the leaves completely cover the ground, thus preventing the growth of weeds and largely also the escape of moisture from the surface.

Thinning.—When the beets begin to show the fourth leaf, and the roots are approximately a quarter of an inch in diameter, they should be thinned. The object of this operation is to leave single beets 6 or 8 inches apart in the row. Large beets are comparatively worthless for sugar making, the content of sugar usually being below 12 per cent. Small beets weighing less than a pound, while rich in sugar, are unprofitable to the farmer because the yield per acre is small. The most profitable yields are secured when the beets average from two to three pounds each, and where a very small proportion of them are branched or "sprangly." To secure beets of the right size and shape there must be but one plant in a place, and the spaces between adjacent plants must not be excessive. Experience has shown that 8 inches is the proper distance between plants in sandy and relatively infertile soils and 6 inches between plants on heavier and more fertile fields.

The first step in the operation of thinning is to cut out, with a hoe having a blade 6 inches wide, spaces in the beet row, leaving bunches 2 inches long of beets. No implement but the human hand has been yet invented by which the strongest plant of each of these bunches is left growing while the weaker ones are removed. In Germany and France this work is done largely by women and children, who become adepts and accomplish far more in a day than the uninitiated could expect to do. The work is very monotonous and exhausting, and it is to be hoped that, within a few years at the outside, American ingenuity will have brought forth a machine which will secure the result without the expenditure of this labor.

All weeds are removed at the time of thinning. Unless the field is unusually clean, the beets should be hoed at least once thereafter in addition to thorough cultivation between the rows. Since it is customary to reject at the factory the parts of the beets growing above the surface of the soil, it is well at the last hoeing and cultivation to throw the dirt toward the row and cover the exposed roots.

Harvesting.—When the leaves cover the ground and the crop has taken possession of the field cultivation should stop and the plants should be given opportunity to fully ripen and to develop saccharine matter. If the cultivation be prolonged and the vegetable growth thereby too much stimulated the sugar content will be diminished. When the outside leaves begin to turn yellow the beets are ripe and should be harvested. The period when the great bulk of the sugar is stored in the beets is usually between August 15 and October 1. Rains thereafter are liable to start a new growth of leaves and lessen the richness in sugar. Harvesting can best be accomplished by a tool made expressly for the purpose, which lifts the beets slightly, thus breaking the taproots and making the work of removing them from the ground and throwing them in rows comparatively easy. Where this tool is used four rows of beets may be thrown into one row, the tops pointing in the same direction. A person then seizes each beet with the left hand and severs the top from the root by one blow of a heavy knife. Care should be used to separate the top from the root at the point where the portion of the beet exposed to the sunlight joins the part of the root entirely covered by the soil while growing. When the beets go to the factory the part of the beet which grew above ground is considered worthless for sugar purposes.

Where the regular "beet lifter" is not used a plow may be run along the side of each row, leaving the roots standing at the side of the furrow. This will greatly lessen the labor of pulling.

The topped beets are either hauled directly to the factory or are stored in pits for future delivery. If, by the terms of the contract, the grower may deliver the major part of his beets before freezing weather sets in, a covering of leaves or a light covering of dirt will be sufficient to protect the pile of beets from sunlight and frost. Where, however, the beets must be kept until late in the winter, the pile must be well covered to prevent freezing.

IMPROVED IMPLEMENTS FOR PLANTING, CULTIVATION, AND HARVESTING.

Sugar beets require peculiar implements from their planting to their harvest. An ordinary plow is sufficient for breaking up the land, and the ordinary corn cultivator, harrow, and roller are useful for stirring, pulverizing, and packing the ground in the cultivations given it prior to planting. But after the beets are planted we must bring into requisition the cultivators peculiarly adapted to the beet fields. We desire a shallow and more narrow plow to thoroughly pulverize the surface of the soil. As it is desirable to cultivate from two to four rows at a time, this implement should be light, effective, and easy of manipulation.

For harvesting we have special implements or plows, designed to break or cut off the taproot of the beet 9 to 12 inches below the surface, lift and thoroughly loosen the beet, and leave it embedded in the soil in which it grew. Some harvesters are in the form of a stirring plow, having an elongated moldboard and a long narrow share. This cuts off the beets and lays them over on their sides. Another form is much like the first, except that instead of a moldboard and share it has two perpendicular bars attached to the beam, shod at the bottom with two round prongs sharp at the points, running parallel with the beam. The prongs are wide apart in front, but the space narrows as they go back; the beet is forced between them, broken off from the taproot, slightly lifted, and left loose in the soil.

Harvesters are constantly undergoing change and improvement at the hands of inventors and manufacturers. It may be stated that many intelligent growers of sugar beets in this country are constantly studying this implement to make it more effective in harvesting beets. There are many difficulties and problems to be met. It must be an implement that will work in hard-packed dried-out ground, among stones, or in loose soil.

The implements above described necessitate the employment of a laborer to follow the plow, lifting the beets from their bed in the loose soil by hand, and removing their tops with a knife especially made for the purpose. The top is usually clipped from the beet near the sun line. Beets are bumped together to remove the dirt and thrown into wagons or put in piles for immediate or future delivery to the factory. This process is called "topping."

Implements have been invented and are in operation for the purpose of topping the beets as they stand in the row. Harvesting machines have been invented which combine topping, harvesting, and loading in one process. These implements differ, but all aim at the same process. They pull the beets, brush off the dirt, clip off the tops, and by the aid of a carrier deposit the beets in a wagon moving alongside the harvester. Some of these machines have been successful under certain conditions.

IMPROVED MACHINERY AND METHODS IN THE FACTORY.

Without beets the factory could not run; without the factory the farmer would have no market for his crop. Every factory management strives in every way possible to induce the farmer to grow the highest tonnage and the best quality of beets. Every farmer owning land whose value has been enhanced by the presence of a sugar factory, and whose conditions have been improved in other ways, is interested in seeing the factory thrive.

The sugar factory and the machinery used in manufacturing sugar from beets have been greatly improved since the first factories were built in the United States. Factories are now constructed of concrete and steel. In these buildings are installed the most modern and effective machinery for producing sugar. The latest, cheapest, and best processes are used in the manufacture of sugar. The artisans employed are men of superior skill and intelligence. In the beginning of our industry we had to import machinery and to imitate the methods, processes, and buildings of the beet-sugar countries of Europe. We were lacking in experience and had very few people acquainted with the subject from which to select beet growers or manufacturers.

In foreign countries the scheme of sugar production and marketing differs from the one we have built up. As a rule, brown (or raw) sugar is manufactured from beets in Europe. The work of refining the sugar and placing it on the market is done by other organizations. The refiners were organized into what was known in Germany as the Kartel. In other countries they were similarly organized, and in most cases the refining organizations have been the potent factor in the marketing of the sugar. The beet-sugar manufacturers proper were largely dependent upon these superior organizations. In this country it became necessary not merely to manufacture a raw product, but a finished article—something that would pass onto the market in competition with the refined product produced from raw sugar brought in from the Antilles and other cane-sugar-producing countries of the Tropics.

The first thing incumbent upon our manufacturers was to install in their factories machinery for finishing and refining their sugars in order to cope with the refineries of the country. As an evidence

of their success, it might be mentioned that the sugar refineries of this country now either control or are considerably interested in nearly half of the factories in the United States. They have entered the field as manufacturers of sugar from beets.

Our beet-sugar factories are installing machinery to conserve all the heat and power generated in their work; for instance, water once heated for a purpose performs several functions. It is distributed to different parts of the factory, serving several purposes, according to temperature required. This saves fuel and time. The same is true with steam, as the following illustrates: In a broad sense sugar extraction, after purification of the juices, is largely a matter of evaporation. A practically organized factory will have three or four evaporating tanks. Heat for evaporation is applied largely by means of steam. It is a well-known principle that evaporation occurs at a lower temperature as atmospheric pressure is removed. Advantage is taken of this principle in the following manner: Where four evaporating tanks are in use, hot steam is applied to the first one, which is kept at a boiling or evaporating point, after which the same steam is conducted through pipes to the second evaporation tank. From this tank, which is hermetically sealed, the air has been partially exhausted and the atmospheric pressure has been consequently reduced so that the juice boils at a lower temperature. After the steam has performed its work here, it is conducted to a third tank where the atmospheric pressure has been reduced still lower, and the steam is still able to produce evaporation of the juice. Still applying this principle, this steam is conducted by pipe to the fourth tank where its heat, though much reduced, is still sufficient to cause evaporation within the tank. Thus we have four evaporators all heated by the same steam, constantly lessening in temperature, but performing the same work in each case—that of eliminating the moisture by evaporation.

The inside work of a sugar factory presents many economical features, such as that illustrated above, further reference to which is not necessary here.

The sugar factory tends to increase the density of population in its district, not only on account of the work demanded in the beet fields, but because the general tendency to intensify agriculture in other directions makes the soil able to maintain a greater population. This increases the business of the community. Customers are increased in number, benefiting the merchants. They have more ready money to expend for the necessaries and comforts of life. All through the intermountain and coast States trolley lines and steam railroads are projected to meet the demands of the increased population and to take care of the increased business.

The farmer, hauling over wagon roads, naturally desires to haul as large a load as possible; this demands good country roads. As a result there is a general demand for the construction of good roads throughout the factory districts, and increased population and business can sustain the expense necessary.

REPORT ON DISPOSAL AND USE OF BY-PRODUCTS.

I desire at this time to offer a detailed report showing to what extent and to what advantage the beet-sugar factories in the United States are able to dispose of their by-products. To secure this information, I addressed the following communication to the manager of every beet-sugar factory in the United States:

DES MOINES, IOWA, *January 2, 1909.*

DEAR SIR: I am now engaged in getting out my twelfth annual report on the Progress of the Beet-Sugar Industry in the United States.

At the suggestion of the Secretary of Agriculture, I want to gather some information as to the use of by-products incident to beet-sugar production. Will you kindly write me a short communication covering the following lines of inquiry:

How much pulp is produced by your factory?

How much molasses is produced by your factory?

How do you dispose of these two by-products?

What is the usual price you receive?

What becomes of the waste lime?

I desire to incorporate in my next report a chapter promoting a larger use of these by-products. If you will kindly write me any suggestions you can offer on this subject I will be under great obligations.

Very respectfully,

CHARLES F. SAYLOR, *Special Agent.*

I submit a digest of the data received in response to this communication. In several instances I publish the response verbatim, in others I simply give a summary of the report. This is the first nearly complete compilation of data on this subject that has ever been made or published. I have obtained information from nearly every factory in this country.

Following my usual custom, I have presented this information in such a way as to avoid revealing the private business affairs of the individual factories. Where there are several factories in a State, I have simply numbered the reports as they came to me, and I report them according to number and State. I have combined and numbered the reports from States having only one factory each in such a way as to avoid revealing the identity of the factories.

These reports show the manner of disposal of the waste molasses. A number of factories have installed either the Steffens or the osmose process for extracting part of the sugar contained in this waste product. In such cases, the residue of molasses is much smaller.

It is interesting to note that in some places the value of waste molasses for feeding purposes is becoming so high as to make it unprofitable for a factory to incur the expense of extracting sugar by either the osmose or the Steffens process. It will be noticed that a few of the factories receive as high as $15 a ton for their molasses for manufacturing alcohol or stock food.

With reference to waste lime, in this country it continues to be practically unutilized. Some of the managers report that it has been applied to the soil as fertilizer in a few cases with good results, but there has been no general demand for its use as a fertilizer or in any other manner. In Germany and France this lime is applied to certain soils with good effect. Eventually it will probably be so used in this country. An analysis of this lime is given on page 32.

CALIFORNIA.

Factory No. 1.—The pulp produced by the factory amounts to 38 or 40 per cent of the original weight of the beets. It is sold to a dairy in the vicinity at 25 cents per ton. The buyer contracts to take care of the pulp and the silo where the pulp is stored after it leaves the mill. At the close of the season he must clean up this silo and put it in shape for the reception of the next year's product. This relieves the factory of considerable work and expense.

The molasses produced will vary from 3.5 to 4.1 per cent of the original weight of the beets, depending upon the process used. This molasses is sold to a distiller for the manufacture of alcohol for $5 per ton f. o. b. cars at factory. In comparison with prices at other factories, this seems to be a very low figure. The distiller, however, is not brought into strict competition with feeders on account of lack of stock in this locality. The manager says:

> During several years we have given the study of utilization of molasses a great deal of attention, but have never been able to convert it into other substances at a profit to this company.
>
> The waste lime of the factory is of little value. Farmers will not take it, even as a gift. The factory uses some of it on its own land, adjacent to the factory, as a fertilizer. Another portion has been used by a small factory in the vicinity with asphaltum in the preparation of roofing and paving materials. It is not conceded that this experiment has been a financial success. The bulk of the lime is disposed of as waste used for filling up low places.

Factory No. 2.—In 1908 this factory produced about 45,000 tons of pulp, for which it received under contract from a cattle-feeding company 20 cents per ton.

It produces between three and four thousand tons of molasses, which is disposed of to a distillery in tank cars, and nets the factory $6.50 per ton.

The waste lime is mixed with the waste waters and used for irrigation.

FACTORY No. 3.—As this report is very interesting, I give it in full:

JANUARY 11, 1909.

DEAR SIR: Based on sales which we make, we estimate that the pulp produced by this factory for this season is 25,800 tons. As you are aware, this by-product never stops wasting after going into the silo, so that in weighing it out from the silo we do not get the same amount as we put in.

We sell this to dairymen almost entirely, very little being used to fatten stock. We realize 50 cents per ton when we sell direct from the factory during beet slicing. Immediately following the end of the run we get a price of $1 per ton, and later on advance the price as it drains out, the highest price which we have ever charged being $2 per ton.

The molasses product is estimated for this season after osmosing at 350,000 gallons. This we sell to the farmers at $1.50 per barrel, so far as possible. Also we have a contract with a vinegar manufacturer who pays us 5 cents per gallon f. o. b. cars here. The balance each year we are compelled to dispose of to distilleries, and the best we can realize is from $2.50 to $4 per ton f. o. b. cars here. Proportionately, the larger part goes to the distilleries.

In regard to waste lime, at one time we sold large quantities of it, to be put on walnut orchards, with what we believed were good results. The price received was 85 cents per ton f. o. b. cars. This refers to our old stock, which was in a pile on the factory ground. Now, however, it is pumped out onto the land with the sewage water. This sewage water has proved a great benefit, the land being flooded with it during the factory run as fast as the beets are taken off, and there is a great rivalry amongst the farmers as to who shall get the benefits.

FEEDING MOLASSES TO HORSES.

I inclose a statement of our experience in feeding refuse molasses to working horses.

As an illustration of the advantages of feeding molasses on hay to working horses, the Lawrence Agricultural Company formerly had an expense of $120 per month for rolled barley. This expense, by the use of 9 barrels of molasses per month, at $13.50 ($1.50 per barrel), has been reduced to an insignificant sum. The method of feeding is to sprinkle the hay with molasses diluted with water, the quantity fed being a quart per horse. The result is that the horses, although continuing their hard work, not only are holding their own, but are standing their work better than on grain, and are sleek and in good spirits. The foreman says he hasn't had a sick horse for two years.

To summarize the cost of feeding 23 head of horses one month:

Without molasses:		
Rolled barley, 4 tons, at $30	$120.00	
Best barley hay, 10 tons, at $18	180.00	
		$300.00
Molasses combination:		
15 tons straw hay, at $6.75	101.25	
9 barrels molasses, at $1.50	13.50	
		114.75
Amount saved		185.25

This experiment has been carried on with these horses for two years. At first it was thought advisable to feed a small quantity of rolled barley in connection with molasses; but it has now been found that it was a useless expense, also that instead of high-priced hay, straw can be substituted with the most satisfactory results.

Factory No. 4.—This factory produces considerable pulp. In the vicinity of the factory is a large feeding district. This pulp is all disposed of to the feeders in the form of green or wet pulp at the spout of the factory, at the rate of 15 cents per ton.

This factory has the Steffens process, and practically retrieves all the sugar in the waste molasses. The little that is left is sold to distilleries at $5 per ton f. o. b. cars at factory.

The waste lime is disposed of through the sewers simply as waste. A few farmers have hauled lime from the factory and deposited it on their soil as fertilizer. For this purpose it has been considered beneficial.

Factory No. 5.—Most of the pulp is sold to local feeders at 10 cents per ton at the factory spout.

The Steffens process is in use, and there is very little residue of molasses. This is sold f. o. b. cars for $3.50 per ton.

The waste lime is pumped out into a settling pond. Some orange growers have been using it on the soil as fertilizer to good effect. The factory received for it $1.50 a ton f. o. b. cars at the factory.

Factory No. 6.—This pulp is disposed of to local feeders at 50 cents per ton, all of it being consumed.

This factory produced about 2,000 tons of molasses, which was disposed of to distilleries for the manufacture of alcohol at $3.50 to $4.20 per ton f. o. b. cars.

No use is made of the lime; it must be disposed of as a waste.

Factory No. 7.—The factory produces in pulp about 45 per cent of the original weight of beets. It is sold to local feeders, practically all being consumed, at 52 cents per ton.

Molasses is disposed of to distilleries for $4 per ton.

The lime is disposed of as waste through the drains and sewers of the factory.

Factory No. 8.—The following is the report of the manager:

January 8, 1909.

Dear Sir: Replying to yours of the 2d, would say that we produced last year only about 12,000 tons of pulp, this being half of the weight of the beets worked. With a normal season we should produce 50,000 tons of pulp. The pulp is all fed to cattle in corrals stationed near the factory. We have in connection with our factory here the Steffens process. Therefore we work up practically all of our molasses. If we make more molasses than our Steffens can take care of, we sell the balance to the distilleries.

The waste lime is pumped into a large hole. As you know, the waste lime is a first-class fertilizer for orchards, and there should be a good market for same in California. Orchard growers, however, do not seem to pay much

attention to fertilization, and therefore there is no call for it. We have offered it to orchardists free of charge if they would haul it away. The United States Department of Agriculture, it seems to me, should get out bulletins and try to introduce this refuse lime as a fertilizer. We will probably next year pump the entire waste waters which contain the lime onto our own lands.

COLORADO.

Factory No. 1.—This factory probably produces 35,000 tons of pulp, all of which is fed locally. The pulp is dropped into silos by conveyors running from the factory. It is allowed to stand and ferment for some time if possible. It is then fed directly to cattle and sheep in adjacent feed corrals. The pulp is delivered automatically by means of small cars to the feed troughs in the pens.

This factory owns considerable land, which it cultivates. It grows large quantities of hay, especially alfalfa, in rotation with beets. The feeder in the same contract buys both the pulp and hay from the factory, the contract covering other privileges incident to feeding.

The pulp sold by the wagonload to outsiders brings 35 cents per ton, as it drops from the conveyor in a wet condition.

No mention is made of the manner of molasses disposal. It is presumed that the same is mixed with the pulp and disposed of as a stock food in a local feeding pen.

The waste lime is slushed away with the final waste waters from the factory and used in irrigating a tract of land near the factory. The manager says:

> The use of this sewage water which contains waste lime and the accumulated washings and other wastes from the factory, put upon the land during the winter months, proves most beneficial in crop returns for the succeeding year.

Factory No. 2.—No information worth mentioning was furnished.

Factory No. 3.—This factory has a large output of pulp. It also uses the Steffens process on the molasses; consequently its output of waste molasses is small. Whatever there is of this residue is mixed with the pulp, and all of both is disposed of to local cattle feeders. The pulp brings from 15 to 50 cents per ton; the molasses from $3 to $11. The lime goes to waste.

Factory No. 4.—The manager says: "We produce about 30,000 tons of pulp and about 600 tons of molasses, both of which products are disposed of to cattle feeders. We receive usually 25 to 50 cents per ton for the pulp and from $3 to $12 per ton for the molasses. The waste lime from our factory is thrown out and not used at all."

Factory No. 5.—The pulp produced averages from 35 to 38 per cent of the beets sliced. It is sold to feeders at the rate of 35 to 50 cents per ton.

The molasses produced for sale is about 2½ per cent of the weight of beets sliced. It is sold to manufacturers of stock-food products and feeders direct at the rate of $11.50 per ton.

The waste lime at present is turned into the sewer and drained away from the factory, having no commercial value.

FACTORY No. 6.—The report of the manager is as follows:

JANUARY 8, 1909.

DEAR SIR: In regard to the pulp produced by our mill, will say this is something we can not figure on closely. It is estimated from as low as 25 per cent of the beets sliced up to as high as 40 per cent. We dispose of this material to people feeding cattle here at the factory, who have a contract for it for the next five years, and also to the dairymen and farmers residing near the factory. We received from 25 to 50 cents per ton for this material.

In regard to molasses, will say that this is another by-product which I can not tell much about. We can make a lot of low-grade molasses or, by using the osmose process, of which there is one installed in our factory, we can make very little. We sell about half of our molasses per season to the people who have the cattle-feeding contract here, and they feed it on pulp and chopped hay. We receive for this material, according to the test, prices varying from $4 to $10 per ton.

In regard to the waste lime, will say that so far we have found no use for this, and most of it is piled here on the company's ground, although a few fruit growers have taken some and put it in their orchards around the trees.

FACTORIES Nos. 7, 8, 9, 10, 11, 12, 13, 14.—I will state that one of the foregoing reports (factory No. 4) contains the combined statement representing nine sugar factories in northern Colorado, all belonging to the same company. The data reported for Colorado represents all the factories in that State except two.

IDAHO.

I have a combined report representing two factories in Utah and four in Idaho, all of which belong to the same company. The report of the manager for the six factories follows:

JANUARY 8, 1909.

DEAR SIR: Answering your favor of the 2d inst., I will say that we operate six factories, two in Utah and four in Idaho.

The six factories will work this year about 400,000 tons of beets. We figure that the pulp product from these beets will be from 140,000 to 150,000 tons, which is disposed of to farmers and cattle feeders on a basis of 35 cents per ton. In some instances this is weighed out, and in others we charge 50 cents per month for the pulp fed to a steer, estimating that the steer will eat 1½ tons in thirty days, and counting 8 sheep or 12 lambs as equal to 1 steer.

We produce in molasses, with our new processes (three factories being equipped with the osmose and three with the Steffens), about 1 per cent of the entire product, or in other words, about 4,000 tons of molasses. This molasses is sold either to cattle feeders or to manufacturers of alfalfa meal. Contracts this year were made previous to a rise in price. We obtain $6 per ton; but, since this contract was made, have had offers of $10 per ton for the same. You must realize that the freight is at least $2 to $3 per ton more than if the same molasses were shipped east from Colorado points.

We have had as yet no market for the waste lime and are piling it up contiguous to our factories, and what we are going to do with it in the future is

quite a problem. Numerous ideas have been suggested, one of which was to manufacture it into Portland cement. As yet the farmers have done very little toward utilizing it on their soils. I think one of the most practical uses for it would probably be that which I have mentioned—the manufacture of Portland cement.

We would prefer at all times that our cattle feeders should use our molasses in connection with the alfalfa rather than to send it east, because from the use of by-products in the locality of the factories we get the resultant fertilizers, which, of course, are very necessary.

MICHIGAN.

Factory No. 1.—This factory produces 15,000 tons of wet pulp, all of which is given to the farmers if they will take it. At the present time, even with this inducement, they are consuming only about half of it, the rest being thrown away.

This factory contemplates installing a plant for drying pulp, in which case this product will be shipped to other parts of the country where there is a demand for it.

The waste lime also is not used. The manager, judging from a few tests, considers it a very valuable fertilizer.

The factory produces considerable waste molasses. It is sold to stock-food producers for $10 per ton. The price of this waste product has been gradually increasing. I quote the manager:

> There is no doubt that the Michigan sugar factories are not realizing nearly as much from their by-products as is done in European factories, and as will be done in the future here. I believe that education along this line from the Department of Agriculture would be a valuable help.

Factory No. 2.—Only part of the pulp can be disposed of to feeders, and this is given away. The rest must be carted from the factory and thrown away, or applied to the sandy soils as a vegetable fertilizer.

Molasses is sold to companies preparing stock food and mixed with dried brewers' grains or by-products from the flouring and cereal mills. The factory receives from $9 to $13 a ton for the molasses.

The waste lime is passed into the sewers and disposed of as waste.

Factory No. 3.—The following is the report of the manager:

January 16, 1909.

Dear Sir: The dried pulp should yield from 5 to 5½ per cent of the tonnage of beets sliced, and the molasses from 2 to 3 per cent, according to the character of the beets.

The dried pulp is handled through brokers, and also sold locally, in small quantities, at from $12 to $17 per ton, according to supply and demand.

The molasses is sold to alcohol manufacturers and also to manufacturers of stock feed, at from $9 to $12 per ton.

Up to date we have found no use for the waste lime.

FACTORY No. 4.—The factory has no drying plant and practically no demand or market for its pulp. A little of it is given away, the balance being disposed of as a useless product.

There is very little waste molasses. The Steffens process recovers most of the sugar. The small balance is disposed of to manufacturers of alcohol. The manager says:

The waste lime from factory is thrown away. We have endeavored to convince the farmers that it is a valuable fertilizer, and induce them to haul it upon their land, but with very little success. An analysis of the lime cake shows that it contains small percentages of potash and phosphoric acid, which, together with the mechanical effect of lime on the soil, makes it a valuable fertilizer; but the farmers are very slow to take it up.

I am inclosing you a copy of the analysis of our lime made by the Michigan Agricultural College.

I think a bulletin on this subject from the Department of Agriculture would be a great benefit to farmers living in the neighborhood of beet-sugar factories.

Limecake analysis.

	Per cent.
Moisture	44.4
Dry matter:	
Insoluble	23.37
Fe_2O_3 and Al_2O_3	4.05
CaO	34.9
MgO	1.16
CO_2	26.00
P_2O_5	.48
K_2O	.07
Organic matter (determined)	9.06
Total	99.63

FACTORY No. 5.—This factory turns out a large amount of pulp, but has been unable to dispose of either the lime or pulp for any practical purpose. Hence they can be counted as waste.

The factory contemplates a drying plant in the near future for preparing stock food from the pulp and molasses.

At the present time molasses is sold to a distillery at the rate of $12 per ton for the manufacture of alcohol.

FACTORY No. 6.—The report of the manager follows:

JANUARY 6, 1909.

DEAR SIR: The capacity of our factory in dried pulp is from 3,000 to 4,000 tons per annum, which pulp is sold to dairymen in the East and has brought for the past two years a price of $23 per ton.

The quantity of molasses produced by our factory varies considerably with the quantity of beets sliced and the quality of the beets. This molasses is sold to the alcohol manufacturers and at a price which varies according to the market.

In regard to the waste lime we would say that a considerable portion of it is used by the farmers for fertilizer with very good results. The balance of it is not utilized.

FACTORIES NOS. 7, 8, 9, 10, 11, 12.—The following report covers all these factories:

JANUARY 9, 1909.

DEAR SIR: This company owns six factories, in three of which we have pulp driers. We have made contracts for the erection of pulp driers at two more the coming season. The amount of dried beet pulp is 5 per cent of the weight of beets cut. There is very little demand for wet beet pulp.

The amount of final molasses produced at our plants is from 2 to 2¼ per cent of the weight of the beets cut. All of our final molasses is sold to a chemical company. The price varies from year to year, ranging from $6 to $10, possibly $12, per ton, $7 to $8 being a fair average.

No special use is made of the waste lime. Farmers use some of it as fertilizer. We have found it specially valuable on hard clay land, also on sandy and muck soil.

FACTORY NO. 13.— The report of the manager follows:

JANUARY 11, 1909.

DEAR SIR: We produce from 25,000 to 35,000 tons of pulp yearly, which is all taken away by our beet growers. A considerable portion of it is run through presses to remove part of the water, and then loaded directly by conveyers into cars and shipped to those who send us their beets by railroad. The balance of this pulp is hauled away by farmers who live within wagon-haul distance of the factory.

For the first two years we had to use considerable persuasion to induce the farmers to try the beet pulp as a stock food, but conditions have so changed that we have no little difficulty in arranging an equitable distribution of the pulp at the present time, as every farmer wants all he can get. This pulp is being used by the best dairy farmers in this section of the country, and they universally indorse it as being one of the best feeds for their dairy cows that they can possibly secure. The writer has talked with scores of them, and they invariably state that when they are feeding pulp their cattle are in a very much better physical condition and their milk cows produce from a quarter to a third more milk than when fed on the regular dry feeds on the farm; in fact, we have farmers in this section who declare that the pulp is fully as beneficial as corn ensilage when fed to milch cows. A number of the farmers fed this beet pulp to their hogs with some ground grains, and they make the statement that they are able to fatten their hogs in about two-thirds to three-fourths the time ordinarily required, although they feed about the same ration of grain they would if they were not feeding pulp.

As to the beet molasses, we are selling this product at the present time to the manufacturers of the molasses-grain feeds. The purchaser supplies tank cars to take it away. The market price for this molasses is about $14 per ton this winter; ordinarily it brings about $10 a ton.

With reference to the waste lime, which is commonly called "limecake," I would say that we have been running this into large settling basins, and only once since we started the factory have we had to clean these basins. At the time we had the basins cleaned we had a part of the lime cake piled up near the railroad tracks, and were quite anxious to have some of the farmers whose land was especially in need of it take this product home and put it on their fields. We succeeded in getting three different ones to take a carload each and use it on their soils. Those who did this found that it improved their land more or less according to the character of the soil. In one instance, where the lime was spread over a low mucky field, on which it had not been pos-

sible to grow anything execept sour grass, the farmer succeeded the following year in growing one of the largest crops of cabbage I have ever seen. In this instance, of course, the land was particularly in need of lime to warm and sweeten it up, and the application showed a very marked result.

I feel satisfied that we will eventually get our farmers to use this lime-cake on such lands as need it, and the day will come when there will be no waste products left about the sugar factory.

We operate to a very considerable extent in a part of the State of Wisconsin, and dairying is being very extensively carried on in a portion of this area. It is not more than three years ago that we were practically unable to get these dairy farmers to undertake beet growing, and we had to rely on what was really the poorer class of farmers to supply us with beets, because the others seemed to feel that they had more work than they had laborers to take care of; but as soon as they begin the feeding of beet pulp, it is the dairy farmers that are taking the contracts for sugar beets, and as this information spreads from one section to another beet growing is becoming more popular. The reason for the change is that they are not only raising a crop which they can sell for a good monetary return, but are getting back this beet pulp without charge (except the freight) and receiving very considerable value in the improved physical condition of their animals and an increased flow of milk from their dairy cows. Besides that, through their animals, they are returning to the soil the vegetable matter and fertility that was sent from the farm when the beets were shipped away. It has been rather a slow process for the farmers to come to a realization of this, but I feel satisfied to make the statement that in Wisconsin, so soon as pulp feeding becomes understood and appreciated, sugar-beet growing will take on an entirely new aspect and a very much greater quantity of beets will be grown than we have ever dreamed of heretofore.

We should very much like to have the Government conduct an experiment along the line of feeding a milch cow, or a herd of them, with beet pulp and then changing them about to corn ensilage, keeping the other parts of the ration the same.

There is one thing in particular that is probably retarding the success of sugar-beet culture in Wisconsin and Michigan as much if not more than anything else, and that is the shallow plowing that is practiced throughout this part of the country. I can state from actual observation that the farmers do not plow on an average 6 inches deep, and it appears to me that a bulletin gotten out by the Department of Agriculture showing the necessity for deeper cultivation, especially for the growing of beets, and the benefits that would accrue to other crops from this method of plowing would certainly be of great asistance to those engaged in this work.

Factory No. 14.—This factory is drying pulp. The drying plant was installed this year.

The Michigan Experiment Station has just concluded and published the results of an interesting experiment with dried beet pulp in comparison with corn in fattening steers.

I reproduce portions of this bulletin containing an account of this experiment and a summary of results:[a]

[a] Bulletin No. 247. R. S. Shaw and H. W. Norton, jr.

DRIED BEET PULP FOR FATTENING STEERS.

With the development of the beet-sugar industry in this State, dried beet pulp has been placed on the market in large quantities and recommended for feeding purposes. Much of it has been used by stockmen and feeders throughout the State and many questions have been asked regarding its feeding value. Dried beet pulp is a by-product of the beet-sugar factory and consists of the refuse pulp which has been dried sufficiently to expel the greater part of the moisture content, so that it can be placed upon the market and handled with other feeds.

Its analysis, as compared with corn meal, given in Michigan Bulletin 234, is as follows:

Dry matter and digestible material in 1 pound of dried beet pulp.

	Dry matter.	Protein.	Carbohydrates and fat.	Nutritive ratio.
Dried beet pulp	0.901	0.075	0.614	8.1
Corn meal	.894	.078	.772	9.8

The protein content is very nearly the same in the two, but the carbohydrates and fat, especially the latter, are considerably higher in corn meal. It would, however, be classed with corn meal as a fattening food according to chemical composition. Several tests have, therefore, been carried on at this station for the purpose of securing information relative to its value for various feeding purposes. Bulletin 220, of this station, treats of the value of dried pulp for fattening sheep. In the tests reported, both plain dried and dried molasses pulp were used against corn, and the conclusions reached were:

(1) Both dried beet pulp and dried molasses beet pulp possessed feeding values comparing very favorably with corn.

(2) Grain mixtures containing dried beet pulp produce mutton at a less cost than similar amounts of grain mixtures alone.

In the tests reported herein, comparisons have been made of the feeding values of dried beet pulp and corn meal for fattening steers. Three trials are reported. In the first, during the winter of 1904 and 1905, only two lots of steers were used, one lot receiving beet pulp in the grain ration, the other receiving corn meal. In each of the two later tests—January to May, 1906, and August to December, 1906—a third lot was entered and received a combination grain ration, consisting of equal parts by weight of the grain mixtures fed to the other two lots.

In making averages only the corn-meal lots and beet-pulp lots are considered, as trial No. 1 consisted of but these two.

Average gain per head daily.

	Corn-meal lot.	Corn-meal-beet-pulp lot.	Beet-pulp lot.
	Pounds.	*Pounds.*	*Pounds.*
Feeding trial No. 1	1.053	.....	1.184
Feeding trial No. 2	1.307	1.408	1.469
Feeding trial No. 3	2.039	1.713	1.670
Average	1.466	.....	1.441

In trials 1 and 2 the rations containing pulp produced the greatest gains, but in the last trial this was reversed—the corn-meal lot gained the most, next the corn-meal-beet-pulp lot, and last the straight beet-pulp ration. In the two earlier tests the animals used were in a growthy condition and were poor in flesh. The steers in the last trial were in very good condition when the test began, carried a fairly thick covering of flesh and were ready to be fed a finishing ration. As a result the corn-meal lot showed up best in gains, while in the earlier tests where the steers were less inclined to fatten readily and finish when put in the test, the pulp lots made the greatest gains. This would seem to substantiate the previous statement that the gain produced by feeding beet pulp is in the form of growth and development rather than in the form of fat.

Average cost of daily ration.

	Corn-meal lot.	Corn-meal-beet-pulp lot.	Beet-pulp lot.
	Cents.	*Cents.*	*Cents.*
Feeding trial No. 1	12.4	.....	10.6
Feeding trial No. 2	10.3	10.1	8.7
Feeding trial No. 3	14.1	12.5	11.0
Average	12.26	.....	10.1

The daily ration was cheaper in each case for the beet-pulp lots than for the corn-meal, the average being 12.26 cents per head daily for the corn against 10.1 cents daily for the pulp, a difference of 2.16 cents per day in favor of the latter.

Average cost per hundredweight of gain.

	Corn-meal lot.	Corn-meal-beet-pulp lot.	Beet-pulp lot.
Feeding trial No. 1	$11.82	.....	$8.97
Feeding trial No. 2	7.89	$7.17	5.96
Feeding trial No. 3	6.90	7.30	6.59
Average	8.87	.....	7.17

In every case the pulp-feed steers gained at a less cost than those fed corn meal, the average being $8.87 per hundredweight of gain when fed the corn-meal ration as against $7.17 per hundredweight of gain when fed the beet-pulp ration, a margin of $1.70 per hundredweight in favor of the beet pulp for cheapness of gain.

The conclusions to be drawn from these three feeding trials, in comparison of dried beet pulp and corn meal for fattening steers, are:

1. Beet pulp produced gain cheaper than corn meal. The average cost per hundredweight of gain for the steers fed corn meal was $8.87, and for beet pulp was $7.17, $1.70 per hundredweight cheaper with the dried-beet-pulp ration.

2. The absolute gains produced by feeding beet pulp were practically the same as from feeding corn meal.

3. The gains of the pulp-fed steers were in the nature of growth and development; the corn meal produced fat and finish. As a result, at the end of the feeding period the corn-meal steers were in better condition for market than the others.

4. For growing animals, beet pulp produced the greatest gains. For animals in a condition for finishing, corn meal gave the most rapid gains.

From this it would be safe to conclude that in the earlier part of the feeding period, beet pulp could be fed in a larger quantity to advantage, because of its cheapness and at the same time ability to produce gain rapidly. During the finishing period it should, however, be replaced at least in a large measure by corn meal, which possesses more value for finishing purposes. The corn meal is a much more concentrated feed, hence its especial value for forcing at the close of the feeding period when beet pulp could not be used. Its bulky character renders it impossible to feed sufficient quantity for the best results. These trials show that a thousand-pound steer will not consume over 10 pounds of dried beet pulp in a day.

WISCONSIN.

FACTORY No. 1.—The report of the manager is as follows:

JANUARY 11, 1909.

DEAR SIR: We produced about 30,000 tons of wet pulp and about 500 tons of waste molasses. The wet pulp is taken by the surrounding farmers for cattle feed; part of it is given to them free of charge and part of it is sold at 75 cents per ton. The molasses is disposed of to some manufacturer of cattle feed, and averages from $8 to $14 per ton.

The waste lime accumulates on a field near the factory as a waste product. A very small percentage of it is used by farmers for fertilizer.

I am of the opinion that it would be more profitable to dry the pulp and mix the dried pulp with molasses, producing a feed which I think would sell on an average for $15 per ton f. o. b. at the factory. This feed would cost about $10 per ton to manufacture, and the quantity would amount to about 5 per cent of the weight of beets cut. It would thus show a profit of 25 cents per ton of beets cut.

What to do with the waste lime is a difficult problem at some factories. Owing to the potash and ammonia salts which it contains, there is more or less of a disagreeable odor to it, and in time it becomes a nuisance. I am told that in Germany it is highly prized as a fertilizer, and I have made many efforts to induce farmers to take it for that purpose, but with very little success so far. There can be no question about its value as a fertilizer, since soils in most cases are deficient in lime, and the potash and ammonia salts extracted from the beets and contained in this waste lime are of course valuable fertilizers.

FACTORY No. 2.—This factory produces considerable pulp and molasses. The manager says:

Pulp is partly given away and partly sold to farmers at 75 cents per ton. Molasses is sold to feed manufacturers at $10 per ton. Wet lime is discharged through waste pipes, and is at present of no value.

FACTORY No. 3.—This factory has installed a pulp-drying plant, and its products are shipped to markets having a demand for it. The price varies according to the market, usually being $14 per ton.

On account of using a process for completing the extraction of sugar from molasses this waste product is very small. The little remaining is sold to manufacturers of dairy feeds at $10 per ton.

Waste lime is used to fill up low swampy lands adjoining the factory.

FACTORY No. 4.—The report of the manager follows:

JANUARY 5, 1909.

DEAR SIR: We have connected with our plant a large drier, which we use for drying the wet beet pulp. We make both plain dried beet pulp and dried molasses beet pulp. In the latter the molasses is mixed in after the pulp goes through the presses, and the mixture goes into the kiln and is dried, after which it is packed in sacks. It makes a very fine cattle food; at least the demands have been very large this season. The price varies from time to time, usually following the market on other feeds. Some parties that have used it seem to like it as well as good bran. The price of molasses also varies with the market.

We make no disposition of the waste lime, although we understand it makes a very fine fertilizer if properly handled.

UTAH AND OREGON.

FACTORIES Nos. 1, 2, 3, and 4.—The following is the report in full for three factories in Utah and one in Oregon, all belonging to the same company:

DEAR SIR: Answering yours of the 2d instant, relating to the use of pulp, molasses, and waste lime, I desire to say that we produce pulp as follows: At No. 1, 13,000 tons; at No. 2, 13,000 tons; at No. 3, 16,000 tons; at No. 4, 2,000 tons. The greater part of this pulp is disposed of by selling it to the beet growers for their own personal use. The remainder is sold to cattle and sheep men for feeding purposes, the cattle and sheep men bringing their animals to the pulp feeding grounds near the factories. The usual price obtained is about 60 cents per ton.

Molasses is produced as follows: At No. 1, 700 tons; No. 2, 750 tons; No. 3, 1,000 tons. After osmosing it we sell the molasses for feeding purposes to eastern buyers at about $6.50 per ton. The production of molasses at No. 4 has been so insignificant that we have done very little with it.

Our waste lime is not being used, it being pumped into the sewer.

FACTORY No. 5.—The report of the manager is given below:

JANUARY 21, 1909.

DEAR SIR: We have received at our factory this year 73,820 tons of beets, which we figure will produce about 33⅓ per cent of pulp if left until February and March before feeding. The above amount of beets will produce about 3,000 tons of molasses. We sell the pulp to stock-feeding people at 50 cents per ton, and we ship some of the molasses east at $3.50 per ton.

Our waste lime is pumped into a settling pond and there it remains, as the farmers do not seem inclined to want to take away any of this waste for fertilizing purposes.

STATES EACH HAVING A SINGLE FACTORY.

FACTORY No. 1.—Wet pulp direct from the factory without going through the process is about 95 per cent of the weight of the beets. The residue molasses is about 6 per cent of the original weight of the beets. It is sold for $10 to $15 per ton net f. o. b. at factory.

The wet pulp is disposed of generally to growers in the vicinity of the factory, while the molasses is shipped outside to stock-food and alcohol manufacturers. The wet pulp is held for sale to others than growers at a uniform price of 50 cents per ton.

The manager says:

No use whatever is made of the waste lime, but we have faith that in future development farmers will learn to appreciate its utility, and this by-product will be greatly sought as a fertilizer. I am led to this conclusion by the longer experience of the German factories. Every pound of limecake is utilized by the farmers there.

Factory No. 2.—This factory has installed a pulp-drying plant. It has a special process for extracting sugar from molasses. The factory is located in a large feeding district demanding the dried-pulp product, for which it receives $18 to $20 per ton. For molasses the price is $14 to $17 per ton f. o. b.

The manager says:

Waste lime was used last year by the beet growers as a fertilizer for which no charge was made.

Factory No. 3.—This is a large plant, and produces in the manufacture of sugar a large amount of pulp. It is estimated that after the pulp goes through the pressing into the silo ready for consumption it will represent about 35 to 40 per cent of the original weight of the beets. It is allowed to remain in the silos until it is thoroughly fermented and drained. It is disposed of to cattle feeders, the bulk of it going to a single contractor, the balance to the farmers in the vicinity. The factory receives 12½ to 25 cents per ton.

This factory is located in a large feeding district, and should receive more for its pulp, but it is one of the newer concerns and must necessarily educate the farmers and feeders to a realization of its value.

The plant has installed the Steffens process for recovering sugar from the molasses. What little molasses is left after this process is mixed with the pulp for feeding purposes.

Waste lime is stored. The management of the factory is making extensive experiments to ascertain its utility for fertilizing purposes. Very little of it is used for that purpose now except experimentally.

Factory No. 4.—This plant has been established for some time. When first built, and for some time thereafter, very little headway was made in inducing the farmers to feed the pulp. At the present time practically all of it is consumed—about half during the slicing season of the factory, the other half being siloed and allowed to ferment.

The factory furnishes fresh pulp to its growers free of charge, as an inducement for growing beets. The balance is sold at the rate

of 20 cents per ton for fresh pulp, or 40 cents per ton for the siloed product.

Most of the molasses is sold to the cattle feeders, the balance to alfalfa-meal manufacturers at about $10 per ton f. o. b.

FACTORY No. 5.—I give below the report of the manager:

JANUARY 7, 1909.

DEAR SIR: The amount of pulp and molasses varies in accordance with the size of our beet crop, hence we can not answer that part of your inquiry. We dry most of our pulp and usually mix our molasses with the pulp, making dried molasses pulp. The balance of the molasses is sold to feed mixers. The dried molasses pulp brings about $20 per ton. The molasses when sold to feed mixers is worth at present about $15 per ton, but the waste lime, that is, lime-cake, has not as yet found any commercial outlet. May we ask you in this connection to kindly advise us if you know of any use for this waste lime?

FACTORIES Nos. 6 and 7.—I copy here the report of the manager:

JANUARY 30, 1909.

DEAR SIR: We are pleased to advise you that we produced by-products as follows:

	Factory No. 6.	Factory No. 7.
	Tons.	*Tons.*
Beet pulp	14,000	30,000
Molasses	1,350	3,000

Pulp is sold in a wet state for stock food. Molasses is sold for stock food and for the manufacture of alcohol. It brings about $12 per ton. Pulp brings 40 to 75 cents per ton.

Waste lime is used to a very small extent for top dressing for land; otherwise as a waste product for fills, etc.

SUMMARY OF REPORTS ON BY-PRODUCTS.

Dried pulp.—Seven factories in Michigan, two in Wisconsin, one in Illinois, and one in New York—eleven in all—have installed plants for drying the beet pulp produced. They find ready sale for this product at prices ranging from $12 to $20 per ton. At some of these factories the molasses is mixed with the pulp.

Fresh pulp.—In California all the pulp is sold in a wet state, the prices ranging from 10 to 50 cents per ton, one factory reporting sales at $1 to $2 per ton for siloed pulp after the campaign closes. A good deal of pulp is bought by farmers, but large quantities are bought by cattle and sheep feeders.

In Colorado, Idaho, Utah, and Montana, demands, uses, and prices of pulp are very similar to those of California. No pulp is dried in any of these States. The demand for fresh pulp for feeding purposes is apparently strong enough to take all the product.

In Wisconsin, Michigan, and other central States, the demand for fresh pulp varies greatly. Several factories report the ready sale of all pulp at prices ranging from 20 to 75 cents per ton. Some Michigan factories, on the other hand, report that the pulp can not be given away, but must be removed as waste at an expense to the factory. In districts where dairying and stock feeding are extensively carried on the demand is comparatively good, and these interests are reported as generally on the increase. A considerable number of factories in these States use the pulp to encourage beet growing by giving it away to their contracting growers.

Extraction of sugar from molasses.—About ten factories use the Steffens process for extraction of sugar from molasses, and perhaps a larger number employ the osmose process. The final molasses by-product of such factories is comparatively small.

Use of molasses by-product.—The molasses by-product of all the factories finds ready sale. A considerable portion of it is bought by distillers for use in the manufacture of alcohol, but much the largest part is sold for feeding purposes. Much of it is used in the manufacture of so-called "molasses feeds." In the West it is mixed with "alfalfa meal." In Michigan, Wisconsin, and some other States it is mixed with dried beet pulp, dried brewers' grains, and other substances. Molasses is also bought to a considerable extent by farmers and feeders, who mix it with other feeds for their horses and cattle.

Prices received for molasses.—The reported prices at which molasses is sold in California range from $2.50 to $6.50 per ton; in Colorado, Idaho, and Utah, from $3 to $12 per ton; in States east of the Mississippi, from $6 to $15 per ton. The average of all reported prices is about $10 per ton.

Disposal of lime.—Nearly all the factories report the so-called "limecake" to be a waste product. At a majority of factories no use whatever has been made of it. In several cases, however, it has been used experimentally as a fertilizer with good results. Several western factories have disposed of the waste lime by mixing it with water used in irrigating the beet fields.

FIELD AND FACTORY RESULTS—BY STATES.

On the whole, the past season can not be considered favorable to the sugar industry. In Colorado, that has stood at the head of the list for some time in producing beet sugar, crop conditions were not so favorable as in California, and the beets produced were inferior to those of Michigan.

There are nine factories in the northern part of Colorado depending on the Platte River for irrigation; there are six in the southern part, where crops are irrigated from the Arkansas River. In this

southern district weather conditions were very unfavorable. Water for irrigation was limited. Drought was quite prevalent. Both the yield and quality of the beets were low. None of the factories ran up to their average capacity. The factory at Lamar did not open at all, beets grown for it being shipped to the factories at Las Animas and Rocky Ford belonging to the same company.

In California conditions were considerably more favorable than in Colorado. Beets grown throughout the State were of high quality.

In Utah the industry fared better as a rule than the year before.

In Michigan the acreage planted was not so large, but the beets produced were of a higher quality than ever before. While the average tonnage was low, in some places the yield was greater than for several years. It was unfortunate that the factories in Michigan did not secure a larger planted area.

While final factory results as a whole have been quite satisfactory in several States, it may be stated that weather conditions were quite unfavorable for planting and germination on an average throughout the country. A considerable part of the contracted area for growing beets in California, Colorado, Utah, Idaho, Michigan, and other portions of the country was planted to other and later crops. A considerable portion of acreage planted to beets failed to respond with a good stand. Weather conditions being unfavorable for replanting beets, this acreage also was put in other and later crops. This explains to some extent the unusual variance between the acreage planted and that actually harvested, as shown in the tables of field and factory results (pp. 54 and 55).

CALIFORNIA.

Alvarado.—In the beet-growing district in this vicinity, up to March 5, prevalent weather and other conditions were of the best. After that date no rain of any consequence fell until the latter part of September. Consequently most of the seed planted after March 5 failed to give a good stand. Considerable of the contracted area was not planted at all.

There were no beet-plant diseases or insects prevalent in this district during the season, except a few wire worms in the earlier planting.

This factory increased the price of beets from $4.50 to $5 per ton.

A self-unloading beet wagon, capable of unloading at the rate of two wagons of 4 or 5 tons each per minute, was introduced and used with success.

All the pulp was fed to milch cows. Molasses, after osmosing, is sold to alcohol distilleries.

Dairying is extensively carried on throughout this beet-growing area and at the factory.

The factory was improved by the installation of conveying machinery for hauling various products, both raw and refined.

Betteravia.—The early season was lacking in spring rains.

An additional traction plow was introduced in the district and did excellent work.

All the pulp here is sold to a cattle-feeding company; the waste molasses is disposed of to distillers.

This company grew 77,371 tons of its own beets. The rest were grown by contracting farmers, who averaged 16.4 tons per acre.

Corcoran.—The lands for growing beets tributary to this factory are new; weather conditions were not the best. Only about 2,500 acres were planted, and the beets grown on these were shipped to the other plant belonging to this company, at Visalia, and the Corcoran factory did not open.

Visalia.—The season was unfavorable, drought causing a heavy loss of acreage. Beet growing is still in the pioneer stage in this area, and the farmers are slow to take it up.

Los Alamitos.—Weather conditions were not very favorable during the season. No rains of any consequence fell after February 20. Considerable of the land growing beets for this factory is under irrigation, which to some extent offsets the effects of drought.

The pulp of this factory is all sold "green" to southern California dairymen. Molasses is sold to farmers, vinegar manufacturers, and distillers. No pulp is dried at this place.

Spreckels.—Weather conditions were generally favorable, and no serious injuries resulted from insects, diseases, storms, or floods. The pulp is used quite extensively for cattle feeding.

Oxnard.—Weather conditions were exceptionally favorable. The season was free from severe winds, and there was less fog and more sunshine than during a number of previous seasons. The total precipitation of 13.82 inches was so well distributed that a crop of average tonnage was produced. In sugar contents and purity the beet crop surpassed all our previous records.

The crop suffered but little from insects and plant diseases. Some small damage from cutworms and a few isolated cases of root aphis were reported.

To a considerable extent the factory has revolutionized the stock business in this section. Formerly stock raising was limited to grazing, but through the use of pulp and molasses feeding for fattening purposes has increased to about seven times its former volume.

Chino.—Although the total precipitation was unusual, too much rain fell early within a short period, and the rains stopped unusually early. This made irrigation necessary. The results, however, were very good both as to tonnage and sugar contents. Slight damage was done by floods, but insects were very little in evidence.

Several thousand cattle are fattened for the market largely on pulp. The dairy interests have not been materially affected, pulp being fed to dairy cows only to a limited extent. The molasses is mostly sold to distillers, but some of it has been fed mixed with cut hay to work animals.

Only about 75 per cent of the beets produced were worked at Chino, the remainder being shipped to Oxnard.

COLORADO.

Nine northern Colorado factories.—These factories belong to the Great Western Sugar Company and depend for irrigation water on the Platte River. They are located at Greeley, Eaton, Longmont, Loveland, New Windsor, Fort Collins, Sterling, and Fort Morgan.

The weather and soil conditions of all the beet-growing districts are quite similar. For planting and early cultivation the weather was unusually cold and for beet growing during the summer it was dry, except for a wet period in the latter part of August and early part of September. In a few localities beets were retarded or damaged to some extent by heavy winds and severe hailstorms during the season. Probably over 2,000 acres of the contracted acreage was not planted.

All the pulp produced by these factories is either used by the feeding interests of the factories or sold to outside feeders and farmers. The same is true of part of the molasses, but some of it is shipped to eastern cattle-food manufacturers. No pulp is dried by any of the nine factories. Stock feeding has gradually increased throughout these districts.

Grand Junction.—Weather conditions were rather unfavorable; it was cold during May and the growing season was unusually brief. No serious losses resulted from insects, plant diseases, hailstorms, or floods.

All the pulp and a portion of the molasses are fed in the company's yards, but part of the molasses is shipped to the east. Dairymen throughout the beet-growing districts generally feed pulp and claim that it greatly increases the flow of milk.

Holly.—Throughout the beet-growing area tributary to this factory the early part of the season was dry, but it was quite favorable during the middle of the growing season and late summer. There was an unusually heavy rainfall in October.

Insect damages were inconsiderable. Curly top was bad on early beets, and some leafspot developed later in the season. Hail caused slight damage.

Pulp is used for feeding purposes in the vicinity of the factory. No pulp is dried.

This company put up a new sugar warehouse in 1908.

Sugar City.—The temperature was normal throughout the planting and growing season, but there was not sufficient rainfall nor water supply for irrigation. The snowfall was rather light in the mountains the previous winter, lessening the supply of irrigation waters flowing through the Arkansas River. Crops in this valley were reduced fully 50 per cent.

The pulp is fed to stock in the company feed lots. No pulp is dried. Molasses is shipped east to stock-food producers.

Lamar.—This factory did not open. The limited crop of beets grown was shipped to the factories at Rocky Ford and Las Animas, which belong to the same company.

A very dry spring and summer, a fall with more than an average precipitation, and an early freeze made the season very unfavorable. Curly top was very bad in the beet fields.

A new machine for pulling and topping beets was tried, but proved unsuccessful.

There is a good demand for molasses and pulp for feeding, dairying and stock feeding being on the increase.

Rocky Ford.—During the winter and spring the weather was very dry, and the spring was cold and late. There was an insufficient supply of water for irrigation. There was an unusual amount of wind during the growing season. Early fall rains increased the hardships of the beet growers. Curly top was very bad in the beet fields.

A part of the pulp is given away to the beet growers. Much of it is sold to feeders and dairymen. There is an increasing demand for pulp for fattening animals, but no perceptible change has occurred along the line of dairying or stock breeding.

Las Animas.—The weather was very dry during spring and summer, and in the fall there were floods and an early freeze. The season was quite unfavorable. Curly top was prevalent in the beet fields.

Part of the beet pulp is given away to the farmers who grow the beets, and the balance is sold to feeders and dairymen. Molasses is sold to feeders and to feed-mixing companies. A great many cattle and sheep are fattened on molasses.

Swink.—Like all districts in the Arkansas Valley, the Swink beet-growing area suffered from drought and scarcity of water for irrigation. Notwithstanding these drawbacks, 7,000 acres of beets were harvested and the factory had a fairly successful campaign.

IDAHO.

Idaho Falls.—The early season was cold and wet and the growing period short. Plant disease and insects caused no considerable losses.

The farmers used about 20 per cent of the pulp, the balance being sold to feeders of cattle and sheep. The factory is not drying pulp. Some of the molasses is consumed by feeders with good results.

BLACKFOOT.—The season was cold, wet, and short. No disease or insects were in evidence.

All the pulp and molasses was sold to farmers and stock feeders. The factory is not drying pulp.

NAMPA.—Weather conditions were rather unfavorable. Very warm, dry weather during a part of the season affected beets to a considerable extent, very much lessening the yield.

There was some blight. The white fly was considerably in evidence and did some damage to the crop.

All the pulp and molasses is sold to local farmers and stock feeders. The factory is not drying pulp. The presence of the factory here does not appear to have exercised any influence on the development of dairying or the feeding and breeding of live stock. The same may be said of other factories in Idaho.

SUGAR.—All conditions were substantially the same as at Idaho Falls.

ILLINOIS.

RIVERDALE.—Weather conditions were not very favorable. It was too wet in the spring and too dry during the latter part of the summer. No particular losses resulted from insects or plant diseases.

The molasses is sold to stock-food manufacturers. This factory is drying pulp and selling it on the market.

IOWA.

WAVERLY.—The weather was quite wet in the spring, and drought in August affected the growing crop of beets seriously. Conditions were such that replanting was not practicable. Heavy rains and hail destroyed considerable of the crop in the northern part of the State and about Cresco, Lime Springs, Chester, Leroy, Iowa, and Taopi, Minn. The 28-inch rows were found much more satisfactory for late cultivation than rows 22 inches apart.

The molasses is sold to stock-food producers. The pulp is fed locally by dairy farmers, very much increasing the flow of milk. The ration is 10 pounds per cow per day. The factory is not drying pulp. The creamery, feeding, and breeding interests have been benefited by the use of this pulp food.

KANSAS.

GARDEN CITY.—This district, like those in the Arkansas Valley in Colorado, suffered severely from drought and shortage of water for irrigation. Consequently there was a heavy loss of acreage and light yield of beets.

MICHIGAN.

Bay City, Caro, Alma, Carrollton, Sebewaing, and Croswell.—The plants at these places all belong to the Michigan Sugar Company.

The season was quite favorable throughout the beet-growing districts for these plants, except a serious drought in August.

Pulp is dried at Alma, Sebewaing, and Bay City, and sold in the market. The rest of these plants dispose of what pulp they can to local farmers and feeders. The molasses of all the plants is sold to alcohol manufacturers. Considerable pulp from several of the plants goes to waste.

Holland.—Weather conditions were not generally favorable to beet production. It was very wet in the early spring, followed immediately by severe drought, retarding plant growth and cutting down the yield about one-half.

All molasses is sold to manufacturers of stock feed. The pulp is mostly used by farmers. Dairying, creamery, feeding, and breeding interests have been materially benefited and increased by the pulp-feeding facilities offered by the factory.

West Bay City.—The season during the planting and growing period was quite dry in 1908. No particular losses resulted from insect pests, diseases, storms, or floods.

Practically all the pulp is dried and shipped east. Molasses is sold to stock-food producers and distillers. Farming and feeding interests have been much benefited on account of pulp produced by the factory.

Owosso.—Weather conditions were as follows: During the month of May it was very wet—7.2 inches of rainfall; 3 inches of rain in July; the balance of the season quite dry. The wet spring contributed to considerable loss of acreage and put the rest of the land in poor condition for cultivation. The crop was not affected by insects or diseases.

The pulp produced by this factory is dried and all of it sold in the markets. Molasses is sold to alcohol distilleries.

Bay City, Station A (Salzburg).—The seasonal conditions were the same as for other factories in eastern Michigan. The yields were not high, but the beets were of very high quality.

Lansing.—The weather was quite wet in spring and early summer, lasting until the middle of June, when drought followed for a considerable period.

This factory is not drying pulp. Not much use is made of molasses or pulp.

St. Louis.—The spring was very wet and cold, seriously interfering with planting and destroying considerable acreage after the beets were planted. This wet weather was followed by drought, materially

affecting the crop. Wire worms were in evidence to a considerable extent, and proved quite destructive.

This factory is not drying pulp, but is installing a plant to be in use next year. The molasses is disposed of to distilleries and others, not feeders. Dairying and stock feeding and breeding have been very materially stimulated. These interests have been doubled in about five years.

Blissfield.—Weather conditions for beet growing were very abnormal during the past season. Very little rain fell, and there was an unusual amount of sunshine. These conditions favor a high percentage of sugar in the beets, but reduce the tonnage. No plant diseases nor injurious insects were in evidence.

The factory is not drying pulp. Considerable pulp is used for feeding purposes locally, and the demand for it is increasing rapidly. Molasses is all sold for the manufacture of alcohol.

Charlevoix.—Weather conditions were quite unfavorable to beet growing on account of drought from the first week in June until the latter part of August. Outside of this there were no adverse conditions affecting beets.

All the pulp is fed locally by farmers. The factory is not drying pulp. Molasses is shipped to manufacturers of stock foods. There is a noticeable increase in the amount of stock in the district on account of the pulp-feeding facilities.

Mount Clemens.—The planting season was too wet and the growing and harvesting season too dry.

The pulp is all dried and the molasses is all sold to manufacturers of stock foods.

The only improvement reported was the completion of the new pulp drier.

Menominee.—This is the only factory in the northern peninsula of Michigan. The season was unfavorable for beet growing, but very favorable for sugar contents and purity of beets.

MINNESOTA.

Chaska.—The weather was exceptionally wet in the spring, and from the 1st of July to harvesting time exceptionally dry. There was no difficulty with insect pests or plant diseases.

Considerable quantities of pulp and molasses are used by beet growers, but the presence of the factory does not appear to have stimulated dairying or feeding. This factory is not drying pulp.

MONTANA.

Billings.—There was a late spring, the summer was too hot, and the latter part of the season was quite wet. There were some slight hail storms, doing no considerable damage.

The pulp and some of the molasses are fed locally. The molasses not used this way is worked up in the preparation of stock food. The factory is not drying pulp. Feeding live stock has increased throughout the district on account of the pulp-feeding facilities.

NEBRASKA.

GRAND ISLAND.—The early spring was cold and dry, no rain falling until April 17, and the weather remaining cold till May 8. After that date the weather became favorable for germination. Thinning was delayed by too much rain. There were no insect injuries, and while plant diseases (Rhizoctonia and *Cercospora beticola*) were slightly in evidence only small damage was done.

All the pulp produced is fed in the vicinity of the factory, also half of the molasses, the other half being taken by manufacturers of alfalfa meal and other feeds. Aside from increased stock feeding, animal industries have not been affected by the presence of the factory.

NEW YORK.

LYONS.—The locality growing beets for Lyons during last season suffered a very long serious dry spell, which considerably reduced the tonnage per acre. There were few evidences of injury from insects or plant diseases.

All the pulp and molasses are sold for feeding purposes. This factory has a drying plant in which it prepares stock food composed of the pulp and molasses from the factory. This is sold to local feeders and in near-by markets.

OHIO.

FREMONT.—Excessive moisture during the early growth of the beets affected the tap roots, and the weather was excessively dry in August, September, and October. There was considerable destruction by hail in the southern part of the beet-growing area during July and August.

The entire supply of pulp is promptly sold, mostly for feeding cattle and lambs. Dairymen in various large cities in the vicinity are feeding pulp with very satisfactory results.

OREGON.

LA GRANDE.—The beet-growing district had a cold, dry spring. This was succeeded by an extremely hot, dry summer. Late rains reduced the sugar content and purity of the beets. There was considerable damage from insects.

All the pulp and part of the molasses are fed by local feeders. The balance of the molasses is shipped to other markets. This factory is not drying pulp.

UTAH.

Ogden.—Immediately following planting there was a long dry spell. The stand of beets was poor, necessitating replanting in many cases. Later the season was quite favorable up to harvest time. Excessive rains occurred at this time, lasting for about two weeks, resulting in "second growth." This produced a large beet with low sugar content and purity. While the tonnage per acre was considerably increased, the total amount of sugar produced by the factory was somewhat reduced.

There was comparative freedom from insect injuries and plant diseases.

This factory does not dry pulp. Most of the pulp is consumed; each beet grower receives his proportion of the pulp and either uses it himself or sells it to neighboring dairymen and cattle feeders. The molasses is all sold to alfalfa-meal factories for cattle feed. Pulp feeding has very materially encouraged and increased dairy, creamery, and cattle-feeding interests. Feeders claim that pulp has revolutionized the method of quickly fattening cattle. It has enabled farmers to go into dairying at a cheaper cost than heretofore. Pulp is easily preserved, and can be fed in the winter when hay and other feed stuffs are high.

Logan.—Early spring was dry; late spring and early summer wet. These conditions delayed thinning three to six weeks, and made a great deal of replanting necessary. The summer season was very good. The early fall was too wet, producing a high tonnage and poor quality of beets. Insect pests and plant diseases caused no particular trouble.

No pulp is dried at this factory. It is used extensively for cattle feeding, each beet grower being allowed as much as he desires up to January 1. After that it is sold to cattle feeders. The molasses is shipped to an alfalfa-meal factory for stock food.

Lewiston.—Conditions here were quite similar to those at Logan.

Lehi.—Weather conditions were quite dry until the middle of May. This was followed by excessive rains until June 1. The summer was short. Rains began September 1, and the precipitation was excessive for ten days. Heavy rains occurred from October 1 to 20. The weather was very fine and favorable following this for forty-five days. Insects and plant diseases caused no serious trouble.

This factory is not drying pulp. About 30 per cent of the pulp is sold to local farmers, the balance to sheep and cattle feeders. The molasses is shipped to Missouri River points and used in the manufacture of stock food.

Garland.—The weather conditions were very similar to those prevailing in the beet-growing districts tributary to Lehi. No plant diseases nor insect pests were in evidence.

The pulp is used in about the same proportion and in the same way as at Lehi. The factory is not drying pulp. Molasses is shipped to Missouri River points for manufacturing stock food.

The plants at Lehi and Garland belong to the Utah-Idaho Sugar Company.

WASHINGTON.

WAVERLY.—Not much was accomplished in the way of production. The company is engaged in active preparations to grow its own beets, and this year made very little effort to secure outside acreage. The company expresses great confidence regarding future success.

WISCONSIN.

JANESVILLE.—The weather was excessively dry from June to October. During the fall there was some rainfall, but even then it was drier than desirable.

This factory is drying pulp. Considerable molasses is mixed with the dried pulp product, the remainder being shipped out in tank cars. Dairying, creamery, and breeding interests have been materially assisted by the pulp by-product for feeding.

MENOMONEE FALLS, CHIPPEWA FALLS, AND MADISON.—Weather conditions and other factors affecting the industry were about the same for these factories as they were for Janesville.

BEET-SUGAR FACTORIES IN THE UNITED STATES.

The following table comprises a complete list of the beet-sugar factories in this country, arranged by States, showing the official names of the manufacturing companies and the location of the factories. It also shows the daily slicing capacity of each factory expressed in tons of beets, and the aggregate slicing capacity of all the factories:

Beet-sugar companies and factories in the United States.

CALIFORNIA.

Manufacturing companies.	Factory locations.	Number of factories.	Daily slicing capacity.
			Tons of beets.
Alameda Sugar Co.	Alvarado		800
Los Alamitos Sugar Co.	Los Alamitos		700
Spreckels Sugar Co.	Spreckels		3,000
Union Sugar Co.	Betteravia		600
American Beet Sugar Co., main office 32 Nassau street, New York; Pacific coast office, 16 California street, San Francisco.	Chino		900
	Oxnard		2,000
Pacific Sugar Corporation, Los Angeles, Cal.	Visalia		400
	Corcoran [a]		600
Sacramento Valley Sugar Co.	Hamilton City		700
Total		9	9,700

[a] Not in operation in 1908, owing to short crops, the beets being shipped to other factories.

Beet-sugar companies and factories in the United States—Continued.

COLORADO.

Manufacturing companies.	Factory locations.	Number of factories.	Daily slicing capacity.
			Tons of beets.
American Beet Sugar Co., 1530 Sixteenth street, Denver, Colo.	Rocky Ford		1,100
	Lamar		600
	Las Animas [a]		700
Holly Sugar Co	Holly		600
Holly Construction Co	Swink		1,200
National Sugar Manufacturing Co	Sugar City		500
The Great Western Sugar Co., general offices, Sugar Building, Denver, Colo.	Eaton		600
	Greeley		600
	Loveland		1,200
	New Windsor		600
	Longmont		1,200
	Fort Collins		1,200
	Sterling		600
	Brush		600
	Fort Morgan		600
The Western Sugar and Land Co	Grand Junction		600
Total		16	12,500

IDAHO.

Utah-Idaho Sugar Co., main office, Salt Lake City	Idaho Falls		1,200
	Sugar		1,200
	Blackfoot		600
	Nampa		750
Total		4	3,750

ILLINOIS.

Charles Pope, Chicago, Ill	Riverdale	1	350

IOWA.

Iowa Sugar Co	Waverly	1	500

KANSAS.

United States Sugar and Land Co	Garden City	1	1,200

MICHIGAN.

Michigan Sugar Co., general offices, Saginaw, Mich	Bay City		600
	Caro		1,200
	Alma		750
	Carrollton		800
	Sebewaing		600
	Croswell		600
West Bay City Sugar Co	Bay City, W. S		600
Holland Sugar Co	Holland		350
Owosso Sugar Co., main office, Bay City, Mich	Owosso		1,200
	Lansing		600
German-American Sugar Co	Bay City, Station A (Salzburg).		650
Mount Clemens Sugar Co	Mount Clemens		600
Menominee River Sugar Co	Menominee		1,200
St. Louis Sugar Co	St. Louis		600
The Continental Sugar Co., main office, Cleveland, Ohio.	Blissfield		600
West Michigan Sugar Co	Charlevoix		600
Total		16	11,550

[a] Not in operation in 1908, owing to short crops, the beets being shipped to other factories.

Beet-sugar companies and factories in the United States—Continued.

MINNESOTA.

Manufacturing companies.	Factory locations.	Number of factories.	Daily slicing capacity.
			Tons of beets.
Carver County Sugar Co.	Chaska	1	600
MONTANA.			
The Great Western Sugar Co.	Billings	1	1,200
NEBRASKA.			
American Beet Sugar Co.	Grand Island	1	350
NEW YORK.			
Lyons Beet Sugar Refining Co	Lyons	1	600
OHIO.			
Continental Sugar Co.	Fremont	1	400
OREGON.			
Amalgamated Sugar Co.	La Grande	1	400
UTAH.			
Amalgamated Sugar Co., office, Ogden, Utah	Logan		600
	Ogden		400
Lewiston Sugar Co.	Lewiston		600
Utah-Idaho Sugar Co., main office, Salt Lake City	Lehi		1,200
	Garland		1,200
Total		5	4,000
WASHINGTON.			
Washington State Sugar Co., main office, Spokane, Wash.	Waverly	1	500
WISCONSIN.			
Wisconsin Sugar Co., main office, Milwaukee, Wis.	Menomonee Falls		500
Chippewa Sugar Co., main office, Milwaukee, Wis.	Chippewa Falls		600
Rock County Sugar Co.	Janesville		600
United States Sugar Co.	Madison		600
Total		4	2,300
Grand total		64	49,900

In addition to the above list, there are three well-equipped factories in this country which were not in operation during the past season. Some of them have been quiet for a longer period. These factories are as follows:

	Tons.
Marine Sugar Company, Marine City, Mich	350
The Arizona Sugar Company, Glendale, Ariz	800
Standard Beet Sugar Company, Leavitt, Nebr	1,100
Total	2,250

STATISTICS OF THE SUGAR INDUSTRY.

Under this head appear (1) the statistics which I have gathered relating to the beet-sugar industry in the United States; (2) statistics of the world's production of sugar (both cane and beet); and (3) a table of German sugar statistics.

STATISTICS OF THE BEET-SUGAR INDUSTRY IN THE UNITED STATES.

ACREAGE PLANTED.

The following table shows the acreage planted to sugar beets in the United States in 1908, and what percentage of this was abandoned owing to unfavorable weather and other adverse conditions:

TABLE I.—*Acreage planted to beets in 1908.*

State.	Planted.	Abandoned.	State.	Planted.	Abandoned.
	Acres.	*Per cent.*		*Acres.*	*Per cent.*
California	72,730	14.3	Wisconsin	16,480	10.8
Colorado	136,216	12.3	Ten other States	42,390	16.9
Idaho	21,768	3.6			
Michigan	99,769	18.7	The United States	421,302	13.4
Utah	31,941	2.5			

The acreage planted exceeded that of 1907 by 20,000 acres, an increase of over 5 per cent, but unfavorable weather conditions, especially during the early part of the season, caused a heavy percentage of abandonment in all the main producing States except Idaho and Utah. The area abandoned for the entire country was 56,389 acres, or 13.4 per cent of that planted. The corresponding loss in 1907 was 7.5 per cent and in 1906, 5.2 per cent. Owing to these heavy losses the acreage harvested was reduced to 364,913 acres, as shown in Table II. This acreage was nearly 2 per cent less than the harvested acreage of 1907, and about 3 per cent less than that of 1906.

GENERAL FACTORY AND FARM RESULTS.

As heretofore, I have depended for statistical data of farm and factory results on the responsible officials of the various factories,

as these are in fact the only persons who possess the desired information. To requests for such data the factory officials have responded promptly, and I believe the data furnished to be accurate. To avoid giving publicity to the business affairs of individual concerns, I present in Table II only the averages for each of the States in which more than one factory has been operated, and general averages for the 10 States in each of which there is a single factory.

TABLE II.—*General factory and farm results of the beet-sugar industry in the United States, 1901–1908.*

BY STATES FOR 1908.

State and year.	Factories in operation.	Area harvested.	Average yield of beets per acre.	Beets worked.	Sugar manufactured.		Average extraction of sugar based on weight of beets.	Average sugar in beets.	Average purity coefficient of beets (a).	Average length of campaign.
					Pounds.	Tons.b				
		Acres.	*Tons.b*	*Tons.b*			*Per ct.*	*P. ct.*		*Days.*
California	8	62,302	10.38	647,085	179,780,000	89,890	13.89	17.66	83.2	88
Colorado	15	119,475	9.28	1,108,961	244,560,000	122,280	11.03	13.85	81.8	78
Idaho	4	20,989	9.80	205,657	52,300,000	26,150	12.72	15.84	86.9	78
Michigan	16	81,073	7.54	611,295	170,598,000	85,299	13.95	17.11	84.8	61
Utah	5	31,152	12.81	399,218	93,390,000	46,695	11.70	14.10	84.1	127
Wisconsin	4	14,700	9.37	137,800	36,640,000	18,320	13.30	16.72	84.5	71
States having but a single factory: c Illinois, Iowa, Kansas, Minnesota, Montana, Nebraska, New York, Ohio, Oregon, Washington	10	35,222	8.65	304,875	74,500,000	37,250	12.22	15.22	82.0	54
Totals and averages d	62	364,913	9.36	3,414,891	851,768,000	425,884	12.47	15.74	83.5	74

TOTALS AND AVERAGES BY YEARS, 1901–1907.e

1907	63	370,984	10.16	3,767,871	927,256,430	463,628	12.30	15.8	83.6	89
1906	63	376,074	11.26	4,236,112	967,224,000	483,612	11.42	14.9	82.2	105
1905	52	307,364	8.67	2,665,913	625,841,228	312,921	11.74	15.3	83.0	77
1904	48	197,784	10.47	2,071,539	484,226,430	242,113	11.69	15.3	83.1	78
1903	49	242,576	8.56	2,076,494	481,209,087	240,604	11.59	/15.1	(g)	75
1902	41	h216,400	8.76	1,895,812	436,811,685	218,406	11.52	/14.6	/83.3	94
1901	36	175,083	9.63	1,685,689	369,211,733	184,606	10.95	14.8	82.2	88
Averages, 1901–1907		269,466	9.75	2,628,490	613,111,513	306,556	11.66	15.1	83.0	87

[a] By purity coefficient is meant the percentage of sugar in the total solids of the substance tested, whether it be beets, juice, or sirup. In this table it represents the average percentage of sugar in the total solids of the beets as determined by tests made at the factories.

[b] Tons of 2,000 pounds each.

[c] Grouped together to avoid giving publicity to data relating to individual factories.

[d] The average yield of beets per acre is found by dividing the total beets worked by the total acreage harvested; the average extraction of sugar by dividing the total sugar produced by the total beets worked; the average contents of sugar, coefficients of purity, and length of campaigns by adding the figures reported by the different factories and dividing by the number of reporting factories.

[e] Compiled from the annual reports on Progress of the Beet-Sugar Industry in the United States for the years named.

[f] These averages are not based on data for all the factories, as some of them failed to report results of tests, but it is believed that they fairly represent the character of the total beet crops.

[g] No data reported.

[h] Based on reports from 27 factories and careful estimates for 14 others.

The totals and averages for the seven years 1901–1907 enable us by comparison to form a just estimate of the success achieved in 1908. Aside from the heavy loss of acreage due to unfavorable weather 1908 must be considered an average year for the industry, although in respect to quality of beets produced and extraction of sugar by the factories, the general averages were remarkably high.

The number of factories in operation was 62, or 1 less than in 1907. Two factories were temporarily closed, the beets produced for them being worked by neighboring factories under the same managements.

YIELD OF BEETS.

The total quantity of beets worked by the factories was in round numbers 3,415,000 tons, or about 9 per cent less than in 1907 and 19 per cent less than in 1906. This falling off in production was partly due to the decrease in acreage harvested. The yield per acre—9.36 tons—while considerably lower than in 1906 and 1907, was nearly up to the average for the seven-year period 1901–1907 and decidedly higher than for 1902, 1903, and 1905.

QUALITY OF BEETS AND YIELD OF SUGAR.

The three factors on which depends the amount of sugar produced are (1) the quantity of beets worked; (2) the quality of the beets; and (3) the completeness of extraction by the factory.

The quality of the beets depends on the sugar content and purity of the beets. In these tables sugar content is expressed as percentage of total weight of the beet, and the purity coefficient represents the percentage of sugar in the total solids, or dry substance of the beet. Both of these are determined by tests in the factory laboratories.

The average percentage of sugar (15.74) and coefficient of purity (83.5) were higher in 1908 than in any previous year except 1907 and were almost equal to the record figures for that year. The beets of 1908 exceeded the seven-year average for sugar content by three-fifths of 1 per cent, which means 12 pounds of sugar for every ton of beets.

This high quality of the beets partially offsets the effect of decreased acreage and lower crop yields. In round numbers the total beet sugar produced in this country for the year 1908 was 426,000 short tons—8 per cent less than the total for 1907 and 12 per cent less than that for 1906.

EXTRACTION OF SUGAR.

The sugar extracted from beets is usually measured as a percentage of the weight of beets worked. No factory, even though its equipment and methods are the best, can extract and transform into merchantable sugar the entire sugar content of the beets worked. The

percentage of extraction is usually from 2 to 4 points below the percentage of sugar in the beets.

In 1908 the rate of extraction averaged 12.47 per cent—the highest general average yet secured in the United States. In 1907 the extraction for the first time exceeded 12 per cent, the average for the six preceding years being 11.5. The gradual increase in percentage of sugar extracted has apparently resulted in part from the general improvement in the quality of the beets and in part from improvements in the equipment and processes used in the factories.

LENGTH OF CAMPAIGNS.

As a natural result of the decreased beet crop, most of the factories were in operation for shorter periods than usual. The average length of campaign for all was seventy-four days, the shortest average period in eight years.

THE WORLD'S PRODUCTION OF SUGAR.

The following table shows the production of sugar (both cane and beet) for 1908–9 in all the principal sugar-producing countries with the corresponding data for 1904–5, 1905–6, 1906–7, and 1907–8 for purposes of comparison. It will be noticed that the grand total is greater than for any year except 1906–7, and that this total is almost equally made up of cane sugar and beet sugar.

Sugar production of the world.[a]

[Prepared in the Division of Production and Distribution, Bureau of Statistics.]

Country.	1904–5.	1905–6.	1906–7.	1907–8.	1908–9.
CANE SUGAR.					
United States:	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Louisiana and Texas	370,531	342,000	243,000	347,000	365,000
Hawaii	380,576	383,225	392,871	465,288	465,000
Porto Rico	145,000	213,000	210,000	200,000	215,000
Total United States[b]	896,107	938,225	845,871	1,012,288	1,045,000
Cuba	1,163,258	1,178,749	1,427,673	961,958	1,350,000
Other West Indies	244,837	302,163	275,257	243,127	257,500
Mexico	107,038	107,529	119,496	123,285	125,000
Central America	19,768	18,516	19,747	19,258	21,000
South America	590,382	700,001	628,777	540,518	722,000
Total America	3,021,390	3,245,183	3,316,821	2,900,434	3,520,500
Asia	3,333,672	2,926,209	3,443,794	3,429,627	3,261,800
Africa	251,340	317,967	326,825	280,000	307,000
Oceania	216,213	230,000	249,000	280,725	231,554
Europe	18,592	15,722	16,400	11,000	22,000
Total cane-sugar production	6,841,207	6,735,081	7,352,840	6,901,786	7,342,854

[a] In long tons, of 2,240 pounds, except in the case of European beet-sugar production, which has been retained in metric tons of 2,204.622 pounds, as originally estimated by Licht; United States beet-sugar data were obtained from reports of Department of Agriculture on the Progress of the Beet-Sugar Industry in the United States; other data from official statistics of various countries, and from Willett and Gray.

[b] Not including the Philippine Islands, which are included under Asia.

Sugar production of the world [a]—Continued.

Country.	1904–5.	1905–6.	1906–7.	1907–8.	1908–9.
BEET SUGAR.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
United States	216,173	279,393	431,796	413,954	380,254
Canada	8,034	11,419	11,367	7,943	6,964
Total America	224,207	290,812	443,163	421,897	387,218
Europe:					
Germany	1,598,164	2,418,156	2,239,179	2,129,597	2,060,000
Austria-Hungary	889,373	1,509,789	1,343,940	1,424,657	1,400,000
France	622,422	1,089,684	756,094	727,712	800,000
Russia	953,626	968,500	1,440,130	1,410,000	1,275,000
Belgium	176,466	328,770	282,804	232,352	255,000
Netherlands	136,551	207,189	181,417	175,184	212,000
Other countries	332,098	410,255	467,244	462,772	500,000
Total Europe	4,708,700	6,932,343	6,710,808	6,562,274	6,502,000
Total beet-sugar production	4,932,907	7,223,155	7,153,971	6,984,171	6,889,218
Total cane and beet sugar production	11,774,114	13,958,236	14,506,811	13,885,957	14,232,072

[a] In long tons, of 2,240 pounds, except in the case of European beet-sugar production, which has been retained in metric tons of 2,204,622 pounds, as originally estimated by Licht; United States beet-sugar data were obtained from reports of Department of Agriculture on the Progress of the Beet-Sugar Industry in the United States; other data from official statistics of various countries, and from Willet and Gray.

SOME GERMAN SUGAR STATISTICS.

I clip from the January number of the American Sugar Industry and Beet Sugar Gazette some very interesting tables. These tables present data of the sugar industry in Germany for every tenth year from 1836–37 to 1906–7. They illustrate the growth of the industry, showing the areas planted to beets, the gradual increase in yield of beets per acre, in percentage of sugar extracted from the beets, in sugar produced per acre, in total sugar production, and in the average capacity of factories; the amount of sugar imported and exported; the total sugar consumed; the growth of per capita consumption; the amount of taxes and customs collected on sugar; and the Magdeburg price of sugar per 100 pounds.

This data is interesting from the fact that Germany is the largest beet-sugar producing country in the world. Ten years ago her exports were about equal to our imports. At the present time she lacks over a million and a quarter tons of producing as much sugar as we consume.

One of the bugaboos of beet production is that sugar beets will exhaust the land; but we notice in these tables that in seventy years Germany has increased the average yield per acre from 7.7 tons to 12.73 tons. It will be noticed further that the factory work has gradually become more effective.

In seventy years, by improved processes and machinery, the factories of Germany have increased the proportion of sugar extracted from beets from 5.55 to 15.69 per cent; the average production of sugar per factory in Germany during this period has been increased

from 11 tons of sugar to 6,026 tons per annum; the importations of sugar have decreased; the exportation of sugar has increased with the growth of production; sugar consumed per capita has increased in seventy years from 4.4 pounds to 41.18 pounds; the price of sugar to the consumer has gradually decreased, and taxes and customs collected have increased with the development of the industry.

Development of the German beet-sugar industry, 1836–1906, as shown by the data for every tenth year.

[Weights in metric tons of 2,204 pounds.]

Year.	Number of factories.	Area in beets.	Beets per acre.	Beets harvested.	Beets worked per factory.	Sugar extraction.	Sugar produced per acre.	Sugar produced.
		Acres.	*Tons.*	*Tons.*	*Tons.*	*Per cent.*	*Pounds.*	*Tons.*
1836–37	122	3,250	7.70	25,346	208	5.55	949.9	1,408
1846–47	107	31,750	8.82	281,692	2,633	7.14	1,392.9	20,121
1855–56	216	114,700	9.50	1,091,990	5,056	8.00	1,675	87,359
1866–67	296	242,025	10.46	2,535,635	8,566	7.93	1,821.1	201,241
1876–77	328	352,185	10.06	3,550,037	10,823	8.15	1,807.28	289,423
1886–87	401	692,222	11.88	8,306,671	20,715	12.18	3,195.8	1,012,968
1896–97	399	1,062,202	12.89	13,721,601	34,390	13.38	3,790.88	1,836,536
1906–7	369	1,110,457	12.73	14,171,666	38,406	15.69	4,385.96	2,223,521

Year.	Average sugar produced per factory.	Sugar imported.	Sugar exported.	Sugar consumed.	Consumption of sugar per capita.	Taxes and customs collected on sugar.	Magdeburg price of sugar per 100 pounds.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Pounds.*		
1836–37	11	51,527	2,230	50,705	4.4	$3,710,129.04	.....
1846–47	188	68,096	10,019	74,628	5.65	4,440,963.04	.....
1855–56	404	46,703	9,545	116,568	7.81	5,775,310.08	$9.49
1866–67	680	6,471	42,975	162,429	9.90	7,501,470.48	6.32
1876–77	882	12,350	60,407	241,365	12.47	11,703,589.20	7.96
1886–87	2,526	4,570	663,266	354,273	16.54	8,069,760.00	4.22
1896–97	4,602	1,620	1,241,230	596,926	24.99	20,854,560.00	2.22
1906–7	6,026	3,117	1,098,835	1,144,629	41.18	33,980,880.00	1.97

PROSPECTS OF THE INDUSTRY IN VARIOUS STATES.

The progress of the beet-sugar industry is largely measured by the increase of the country's capacity for manufacturing sugar. This increase is gained principally by the establishment of new factories, but not in that way alone. Many of the established factories are making improvements. Some are adding to their capacity; some are installing improved machinery, inaugurating better methods, and building subsidiary plants to work on the by-products, or to extract sugar from the molasses.

Many of the companies have installed extensive feeding lots to accommodate large bunches of cattle or flocks of sheep. Feeders are allowed the privileges of these feeding facilities. The chief object is to facilitate the use of pulp. In some cases the factory owners have engaged in stock-feeding enterprises. All these additions and improvements are features in the progress of the beet-sugar industry.

Last year only one new factory was added to the list of beet-sugar plants in this country, the one at Corcoran, Cal., with 600 tons capacity.

Capitalists, promoters, business men, landholders, and others continue active in planning additional enterprises for new places. In a great many places organizations have been formed and preparations made to install new beet-sugar plants whenever conditions seem opportune. Under this head I will discuss some of the more important prospects in the various States.

ARIZONA.

Three or four years ago, a factory of 800 tons capacity was built near Glendale, Ariz. This operated for a couple of weeks two years ago. Water facilities were found inadequate to properly meet the needs of the factory. It appears also that the plant was not sufficiently capitalized for its successful manipulation. Several things interfered with the success of the enterprise. The plant went into the hands of a receiver, was compelled to shut down, and has since been idle.

Considerable beets were grown at that time, most of which were allowed to rot in the ground or in piles, on account of the factory not being in condition to use them.

This plant has recently been purchased by parties operating as The Southern Sugar and Land Company. It has been thoroughly overhauled and equipped for sugar production. It is now in the hands of men experienced in manipulating such an enterprise, being practically the same parties that restored the Grand Junction (Colo.) plant to a useful career. A large acreage of beets has been planted. The factory will start on its campaign about the middle of May, producing beet sugar, and will no doubt continue as one of the successful plants of the country.

CALIFORNIA.

There are nine sugar factories in this State, well equipped and generally successful enterprises. Results of the past have thoroughly established the beet-sugar industry in this State. There are many conditions in California peculiarly favorable to this industry. The climate is mild. Rainfall is usually sufficient for growing sugar beets. Climatic conditions permit all planting earlier than in most parts of the United States. This occurs from December to June 1, according to local conditions. Growers can plant their beets at such times as will enable them best to utilize the rainfall. As a rule in this State the rains come in the winter, say from January 1 to April 1, and they are sufficient to quickly and thoroughly start the

young plants in their growth. The soil is of such a nature that it readily absorbs and holds a supply of moisture which is usually sufficient to mature the crop. The long planting period enables factories to harvest beets during a long period on account of their successive dates of maturity. This enables the factories to work longer.

Formerly beets were grown in California almost entirely by moisture supplied by rainfall, but gradually irrigation has been brought into service. Water is drawn from running streams or it comes from flowing wells or is pumped from underground supplies. There are many districts in the State where water flows strongly from deep wells, and large areas are now irrigated from these flowing wells.

Santa Ana.—A plant is now building at Santa Ana, which is located in Orange County, in southern California. The site is about 2½ miles south of the town. It will have 600 tons daily capacity. The structure will be of brick, steel, and concrete, 76 feet wide and 265 feet long, the main portion being four stories high.

This district has grown sugar beets extensively for the factories at Los Alamitos and Chino. It is located in a district where conditions permit of an early opening—about July 1. The construction of the plant is under good headway. By the first of March (1909) the building was nearly completed and most of the heavy machinery installed. It should be completed and in readiness some time before the time for opening the campaign. An electric trolley line is being built from the town to the factory, connecting it with the transportation lines in the city. This will facilitate the delivery of beets in carload lots.

COLORADO.

Colorado is now the most important State in the Union in the production of sugar from beets. It has many conditions peculiarly suited to the sugar industry. As a rule beets are grown on irrigated land. These beet lands are in the valleys lying along streams which have their sources in the Rocky Mountains. These mountains receive heavy deposits of snow in the winter. As these slowly melt in the spring and summer the water flows through the streams—the Platte and Arkansas rivers, and others—whence it is taken out by ditches and distributed over the cultivated lands.

The State is generally adapted, where sufficient water can be secured for irrigation, to alfalfa and the small grains. These crops, in connection with beet growing, present a fine opportunity for crop rotation and the development of the stock industry.

There are many places in the State having well-matured plans for building additional sugar factories and among which the following may be named: Fort Morgan, Lone Tree, Alamosa, Fowler, Pierce, Olathe, Wylie, Kuner, and Delta.

DELTA.—I have a report from W. P. Dale, president of the Delta County Business Men's Association, who states that under this association 1,700 acres were grown in 1908, producing an average of 12 tons per acre, the sugar content being 14 per cent and the purity 79. The total cost of production per acre was $35, including compensation for the farmers' time. The Government is constructing here a large irrigation project known as the "Gunnison tunnel," which is nearly completed. This will afford this district abundant facilities for irrigating land. It is quite probable that a factory will be installed here in the near future.

ILLINOIS.

Illinois has at present one sugar factory, located at Riverdale, near Chicago. This State has many facilities and conditions adapted to this industry, the principal ones being shipping facilities and local markets. Experiments have generally demonstrated a sufficient adaptability of the soil to this purpose. Several places are seriously considering the building of factories. Those worthy of special mention are Genoa and Elgin.

KANSAS.

Kansas has one large sugar factory, located at Garden City. The sugar industry in the State seems best adapted to the western part, where beets must necessarily be grown by irrigation. Water for this purpose is taken out of the Arkansas River. Climatic and other conditions are quite similar to those obtaining farther west along the same river in the eastern part of Colorado, where there are six factories.

There are a number of places in the State where the establishment of other plants is under contemplation, especially St. Francis, Lakin, and Great Bend.

A report from O. W. Dawson, secretary of the Great Bend Sugar Beet Association, states that under the direction of this association 25 acres of beets were grown experimentally on four different soils, ranging from heavy black gumbo to sandy soil. The sandy soil produced the heaviest tonnage, which ran from 16 to 22 tons per acre. The sugar content of the beets ranged from 12 to 16 per cent and the purity from 74 to 76.

LAKIN.—I have a report from William Logan, of Lakin, giving details of experiments conducted during 1908 at that place, showing the analysis of the beets grown and the cost of production of 5¼ acres:

Actual cost of growing and marketing 5¼ acres of beets at Lakin, Kans.

Water and labor in applying	$3.00
Plowing	11.00
Harrowing three times	3.00
Planting	2.50
Thinning	31.50
Hoeing twice	10.00
Cultivating four times	14.00
Water and labor for two irrigations	6.00
Plowing out beets	7.50
Topping	15.00
Hauling one-half mile to market	11.00
Total	114.50
Average cost per acre	21.81

MONTANA.

All parts of Montana have been thoroughly tested experimentally as to conditions for producing sugar beets. There is a large factory at Billings which conducted its second campaign in 1908. Beets for this factory are grown over wide areas. Beets are being grown experimentally in several places and disposed of to this factory. In all parts of the State where sufficient water is procurable for irrigation, general adaptability to the beet crop has been demonstrated.

The places most prominently under consideration with good prospects of establishing sugar factories are Dillon, Harlem, and Big Timber.

DILLON.—I inclose a communication from Geo. R. Featherly, who has charge of experiments conducted under the direction of the Beaverhead Sugar Beet Growers' Association at Dillon, Mont. With this communication he sends analyses of beets grown in that district last year. These indicate excellent quality, both as to sugar contents and purity.

BEAVERHEAD SUGAR BEET GROWERS' ASSOCIATION.

DILLON, MONT., *February 3, 1909.*

Mr. C. F. SAYLOR, *Des Moines, Iowa.*

DEAR SIR: In response to your request, I am inclosing you the list of men who grew beets last year. You will note by the blanks there were many men who did not take care of their beets. The yields per acre have been estimated in all cases except the Beaverhead Ranch Company and myself, whose beets were actually weighed; but I think the estimates on the others are about right. The beets were analyzed at the sugar factory at Idaho Falls.

We are expecting to put in at least 500 acres this spring, and I am confident that we will have better results than last year, because we know more about taking care of beets.

Respectfully, yours, GEO. R. FEATHERLY, *President.*

Results of a beet-growing experiment in the vicinity of Dillon, Mont., in 1908.

Name and address of grower.	Size of plat.	Sugar in beets.	Purity coefficient.	Yield per acre.
DILLON.	*Acres.*	*Per cent.*		*Tons.*
W. M. Oliver	½	12.4	78.3	16
Louis Stahl	½	13.9	80.8	18
Jake Watson	½	17.2	89.3	14
Tom Wilson	½			
Mrs. Reynolds	¼			
Peter C. Peterson	¼			
Martin Sorenson	¾	16.6	85.9	14
Wm. Klien	½			
Emerick Bros	1	17.4	89.2	10
Jens H. Christensen	½	17.7	88.6	14
Geo. Rebich	½	16.8	88.1	12
Joe Heavy	¾	15.9	86.9	10
John Lovell	¾			
John Butala	¾			
Mike Rehich	1			
Markus Staudaher	1	16.8	84.9	18
Sam Freeman	¼			
—— Hunter	¼			
J. W. Ewing	1	16.4	87.3	14
Paul Shultz	½	17.4	86.6	10
A. S. Banning	½	17.3	86.5	14
Elzy Smith	1	13.7	82.5	19
A. S. Rife	½			
Beaverhead Ranch Co	½	14.9	84.8	12
Nels Jensen	½	14.5	84.2	10
Mike Lauterhaugh	½	15.6	86.5	14
Hawley Selway	½	17.9	89.1	10
Chas. Hanson	½			
Geo. R. Featherly	1	15.4	86.8	14
Matt Torensen	⅓	15.5	86.1	10
Jno. Banks	½	17.7	87.8	12
Neil Solmenson	¼			
W. G. Roberts	½	15.3	83.9	18
John Milich	1	15.6	84.3	14
Peter Jensen	½	14.5	81.1	10
W. F. Drummy	⅓	14.1	80.9	10
Chas. Menee	1			
Ras. Henningsen	⅓			
Theodor Nelson	1	16.5	86.7	9
Louis Sorenson	½			
Peter G. Nelson	½	18.5	88.6	14
Wm. Barbour	1¼			
WILLIS.				
Jas. Garrison	½	16.5	87.8	10
Carl Behrer	¼	16.8	86.4	12
Jacob Hartwig	½			
Stephen Camhitch	½	15.7	87.5	10
Matt Polish	½			
MELROSE.				
J. A. Brown	½			
R. R. Hoffman	½	13.9	82.0	12
Ira White	½			
Farlin & Champion	1	14.4	81.3	10
Chas. Lindlief	½			
Chas. Schultz	1¼			
F. P. Tate	1	14.3	84.3	10
Poindexter & Orr	1			
ARMSTEAD.				
Scott & Decker	½	13.9	80.0	10
Ed. Roe	¾			
Jno. B. Hill	½			
LIMA.				
W. E. Gerry	¼	14.4	84.5	20

HARLEM.—Referring to Harlem, I inclose a report made by Frank T. Mann, clerk in charge, Fort Belknap Indian Agency, at this place. This discloses the interest the Government is taking in the sugar industry as a means of employing the lands and services of the Indians.

FORT BELKNAP AGENCY,
Harlem, Mont., January 23, 1909.

DEAR SIR: You are advised that under authority of the act of Congress of March 1, 1907 (37 Stat. L., 1034), the Indians of this reservation, by W. R. Logan, superintendent, and the business council of the Indians, on October 7, 1907, leased 10,000 acres of land to David Eccles, Henry H. Rolapp, and Matthew S. Browning, one-half of said acreage to be cultivated annually in sugar beets and the other half in some rotating crop. Since this lease was made a contract has been entered into with Mrs. Rose Stevens to cultivate 1,000 acres of land on the reservation, and applications for two other leases of a thousand acres each are on file. The conditions of the lease to Eccles and others are that the lessees are to establish a factory in close proximity to the reservation so as to furnish a market for the beets produced thereon. Work on this factory will be begun in the spring or summer of 1909. Approximately 4,000 acres of land on the reservation has already been broken and the same will be sown in a cereal crop this coming spring with a view to planting it in beets in 1910.

Very respectfully,

FRANK T. MANN,
Clerk in charge.

NEBRASKA.

Experimentation still continues looking to the further development of beet-sugar production in Nebraska. This State has had three sugar factories, all in the eastern half of the State where crops are grown under rain conditions. They were located at Grand Island, Norfolk, and Leavitt. The one at Norfolk, belonging to the American Beet Sugar Company, was removed to Lamar, Colo. This company had a large tract of land at that place, and considered that it would kill two birds with one stone by removing this factory to that point. There it serves the purpose of manufacturing sugar and developing the values of the land.

The one at Leavitt was operated several years with a capacity of 600 tons. The company doubled its capacity at a large expense. The year following this improvement the beets grown were very poor in quality. The factory got into financial troubles and into court, went into the hands of a receiver, and has been idle for a couple of years.

The conditions most favorable to beet production according to recent developments and the best judgment of men familiar with the conditions have shifted from the eastern to the western part of the State. Before the Leavitt factory closed a large acreage of beets was grown around North Platte, McCook, and in other districts where beets were grown by irrigation. The last year the Leavitt factory was in operation, in these western districts about 11,000 acres were grown for it and the factory at Grand Island. These beets were of high quality and the yields were good.

North Platte and McCook and other places in western Nebraska have been under serious consideration by capitalists and others with a

view to establishing beet-sugar factories. Indications are that such enterprises will be established before very long.

Other places that have been considered seriously during the past year are Bridgeport and Mitchell.

MITCHELL.—Referring to Mitchell, I have a report from J. T. Whitehead, of that place. He gives some of the results of experimentation during 1908:

MITCHELL COMMERCIAL CLUB,
Mitchell, Nebr., January 14, 1909.

DEAR SIR: I have your favor of the 9th. It is somewhat difficult to give all the information you want in exact figures, but I am able to give it approximately.

There were grown in this valley about 1,800 acres of beets, and the yield was in the neighborhood of 14 tons to the acre. This was a bad year in all parts of the country for sugar beets, and so our yield was lighter than ordinarily. This was true to a greater extent in Colorado than with us. The beets tested, as nearly as we could find out, from 15 to possibly 17 per cent of sugar. The only test that I can learn of as to purity was 83.

The cost of production is problematical. The hand labor is $20 per acre, and the seed costs about $3 per acre. The cost of tending the beets in the way of team work is the same as is necessary to raise a corn or potato crop. One man and a team can tend easily 50 to 75 acres, and some tend even more than that. Hauling to the station varies according to the distance. Within a mile it is usually 50 cents per ton, and up to about 4 miles, $1 per ton. If the farmer does his own hauling, then the cost is whatever he considers his time worth to him.

We are now negotiating with the Great Western Sugar Company, of Denver, Colo., with the idea of securing a factory to be located here, and we have some prospect of success. We have a subscription list of about 11,000 acres for the location of a factory here.

Yours, truly, JAS. T. WHITEHEAD, *President.*

NEVADA.

Nevada has been conducting some interesting experiments at the upper end of Carson Valley, in the west form of Carson River, near Reno. Through these developments considerable interest is manifested in the beet-sugar industry.

NEW MEXICO.

New Mexico continues to do considerable experimentation in relation to the beet-sugar industry. There are several places in the Territory with plans very well matured for building sugar plants.

Some years ago a small plant of 200 tons capacity was established at Carlsbad. The plant was too small to cope with facilities of modern plants with better machinery and of larger capacity. This plant burned down. The beets grown at that time were of very good quality and the yield was quite satisfactory.

Places under consideration at the present time are Elmendorf, Las Cruces, and French.

A large tract of land has been purchased in Miguel County. The company plans colonizing and preparing this land for growing sugar beets. It proposes the establishment of a sugar factory in the near future. This is about 20 miles south of Las Vegas, and is known as the "old Antonio Oritz land grant." The purchasing company is located at Topeka, Kans.

NORTH DAKOTA.

Considerable experimenting has been done in the State of North Dakota. There are many places adapted to the beet-sugar industry. The chief trouble at the present time is the lack of labor and capital. The places under consideration are Oaks and Williston.

OREGON.

Oregon has one factory located at La Grande. There are a number of places in the State adapted to the beet-sugar industry.

One of the chief obstacles in this State is lack of transportation facilities. In most cases where beet-sugar enterprises are under consideration it will be necessary to build railroads and other facilities. The place receiving most consideration now is Enterprise.

TEXAS.

There is considerable interest manifested in different parts of Texas regarding the beet-sugar industry. Extensive experiments were carried on during 1908, with excellent results in some places, especially in what is known as the Panhandle district and territory adjacent having conditions quite similar.

Beet growers' associations have been formed and companies tentatively organized in a number of places. Railroads have taken quite an interest in promoting this industry. The particular places are Dublin, Stratford, El Paso, and Amarillo.

In order to ascertain the results of experiments carried on in that State during the past year, I have been in communication with the Texas State Agricultural Experiment Station, the St. Louis, San Francisco and Texas Railway Company, and the Fort Worth and Rio Grande Railway Company. From these sources I have secured the data which follow.

The Texas State Experiment Station has been conducting experiments from time to time in growing sugar beets in different localities. These beets have been analyzed by the chemist of the State agricultural college. I present a table showing locality in the State where the beets were grown, and their sugar contents and purity. It

will be noticed that the last five samples in the list showed high quality. These beets came from the northwestern part of Texas—the Panhandle district.

Analyses of sugar beets grown in Texas in 1908, under the direction of the State experiment station.

Sample No.	Where and by whom grown.	Sugar content.	Coefficient of purity.
		Per cent.	
171	From G. Fellbaum, Comfort, Kendall County	6.8	62
198	From S. G. Carter, Miami, Roberts County	11.5	57
265	From C. A. Walton, Victoria, Victoria County	9.0	.....
305	From King Ranch, Kingsville, Nueces County	9.5	68
350	From C. A. Walton, Victoria, Victoria County	4.6	.....
967	From Kelley Smith Co., San Saba, San Saba County	10.0	.....
1332	From N. R. Gregg, Corpus Christi, Nueces County	16.0	66
1357	From Theo. F. Koch & Co., Riviera, Nueces County	7.3	66
1419	From D. N. McEachern, Garrison, Nacogdoches County	11.7	75
1491	From J. D. Dodson, Royse City, Rockwell County	7.5	71
1728	From W. B. Carnes, McKinney, Collin County	8.5	77
1959	From Geo. E. Barstow, Barstow, Ward County	16.0	80
1970	From J. S. Wyche, Hereford, Deaf Smith County	16.3	73
2044	From J. S. Wyche, Hereford, Deaf Smith County	16.0	80
2045	From J. S. Wyche, Hereford, Deaf Smith County	16.0	80
2093	From J. J. Ellerd, Plainview, Hale County	13.3	77

The St. Louis, San Francisco and Texas Railway Company and the Fort Worth and Rio Grande Railway Company have been making some extensive tests in Texas relative to the commercial production of sugar beets in parts of Texas adjacent to these roads. They have kindly furnished me tables showing the results. The following is a list of the men under whom the beets were grown:

Mr. G. Z. Hollingsworth, Stephenville, Tex.
Mr. J. R. Smith, Blanket, Tex.
Mr. G. W. Scott, Blanket, Tex.
Mr. A. Faulkner, Comanche, Tex.
Mr. J. D. Caldwell, Brownwood, Tex.
Mr. N. D. Smith, Dublin, Tex.

The analyses were made by H. A. Vallez, superintendent of the German-American Sugar Company, Bay City, Mich.

Results of analyses of beets grown at different points in Texas, in 1908, under direction of railway companies.

Locality.	Average weight.	Gravity.	Sugar in juice.	Sugar in beets.	Purity coefficient of juice.
	Ounces.	*° Brix.*		*Per cent.*	
Brownwood	21	20.5	16.4	15.1	80.0
Do	40	15.0	11.9	10.9	79.3
Do	20	17.1	14.3	13.2	83.6
Stephenville	20	15.0	11.6	10.7	77.4
Blanket	16	19.0	16.1	14.8	84.7
Port Worth	13	14.8	.....	9.6	70.3
Stephenville	18	16.9	.....	11.1	71.6
Dublin	24	15.9	.....	10.4	71.1
Blanket	16	16.7	.....	11.0	71.9
Comanche	20	14.5	.....	9.6	71.7

Results of analyses of various samples of beets grown in Texas in 1908 under direction of railway companies.

Sample No.	Number of beets.	Average weight.	Gravity.	Sugar in juice.	Sugar in beets.	Purity coefficient of juice.
		Ounces.	*° Brix.*	*Per cent.*	*Per cent.*	
1	2	36	15.5	11.4	10.5	73.5
2	2	26	15.7	12.1	11.1	77.0
3	2	26	16.2	12.9	11.9	79.6
4	2	28	15.7	12.0	11.0	76.4
5	2	24	15.2	11.6	10.7	76.3
6	2	16	17.6	14.0	12.9	79.5
7	2	11	16.9	13.0	11.9	76.9
8	2	28	17.4	13.9	12.8	79.9
9	2	18	17.8	14.5	13.3	81.5
10	1	26	15.6	11.2	10.1	71.8
11	3	11	17.7	14.6	13.4	82.5
12	2	11	17.4	14.1	12.9	81.0
13	2	11	18.5	14.7	13.5	79.4

Analyses of Texas beets of different sizes.

	Average weight.	Gravity.	Sugar in juice.	Sugar in beets.	Purity coefficient of juice.
	Ounces.	*° Brix.*	*Per cent.*	*Per cent.*	
Large	44	16.1	11.3	10.4	70.2
Medium	23	15.6	11.8	10.9	75.6
Small, long	19	17.9	14.3	13.2	79.9

VIRGINIA.

Extensive experiments have been conducted in Virginia to test conditions relating to the beet-sugar industry. As a matter of fact, a factory was built in this State at Stanton in 1892. This was one of the early efforts. It was operated one or two campaigns and finally burned down. Previous experiments and the experience of this factory did not indicate favorable conditions. Recently interest in the subject has been revived.

Climatic conditions as far south as Virginia, or below what is known as "Mason and Dixon's line," are not naturally favorable to beet-sugar production. There are places, however, where higher elevation overcomes unfavorable conditions, and where sugar beets of sufficient quantity and quality are grown.

The Norfolk and Western Railway Company in 1908 took up this matter exhaustively and practically. It conducted experiments in growing sugar beets throughout the territory tributary to its lines. It made careful investigations and a detailed study of experimental requirements. It procured the best seed and drew to its service specialists thoroughly qualified to conduct the experiments. This transportation company has spared no expense to secure practical tests of conditions as regards the beet-sugar industry in Virginia. The chief specialist conducting this work was Mr. Rodenbeck. He

was furnished all the modern implements, leases on plats, equipment, seed, and other requisites for making an exhaustive study.

The report of this company indicates yields of 14 to 16 tons per acre. The plats used in the experiments ranged from one-sixteenth to one-eighth of an acre in size.

This transportation company has detailed reports on the results of the experimental work conducted during the past year. From the analyses given the following statistics have been selected as fairly representative of the best results secured:

Selected results of analyses of beets grown in Virginia in 1908.

Name and address of grower.	Date of test.	Sugar in juice.	Sugar in beets.	Coefficient of purity of juice.
MARION.	1908.	*Per cent.*	*Per cent.*	
H. P. Copenhaver	Nov. 9	14.60	13.40	81.1
J. K. Groseclose	...do	13.90	12.79	84.2
Do	Nov. 5	15.20	13.90	82.2
ATKINS.				
C. P. Schrock	Nov. 7	14.20	13.10	82.1
Do	Nov. 9	15.00	12.40	80.9
C. L. Wassum	...do	16.00	13.80	82.4
Do	...do	16.30	15.60	86.9
V. D. Hoofnagle	...do	16.90	15.55	92.0
SEVEN-MILE FORD.				
J. J. Hankla	Nov. 10	15.60	14.38	84.3
G. W. Tyler	...do	14.10	12.70	81.5
W. N. McGhee	...do	15.20	13.98	80.4
GLADE SPRINGS.				
J. R. Hendricks	Nov. 9	9.90	9.10	75.0
STUARTS DRAFT.				
W. B. Dodge	Nov. 16	16.75	15.41	88.9
M. S. Schindel	...do	14.50	13.34	83.3
GROTTOES.				
R. W. Patterson	Nov. 16	13.50	12.42	83.8
J. D. Grove	...do	13.85	12.74	79.9
Do	Nov. 19	14.50	13.50	80.6
J. B. Backs	Nov. 16	11.55	10.63	73.0
TROUTVILLE.				
S. C. Showalter	Nov. 13	14.00	12.88	85.4
RURAL RETREAT.				
S. M. Cornett	Nov. 11	15.15	13.94	83.1
J. B. Painter	...do	14.80	13.62	86.5
J. S. Brown	...do	14.40	13.25	87.8
J. G. Heldricks	Nov. 17	14.20	14.00	81.8
Do	Nov. 11	17.05	15.69	88.5
PULASKI.				
Wysor Marsh	Nov. 9	14.02	13.00	83.0
J. K. S. Bell	Nov. 14	16.50	15.20	85.5
Do	Nov. 5	17.10	15.70	88.2
Do	Nov. 11	15.40	14.17	83.2
DUBLIN.				
R. E. Wysor	Nov. 10	17.10	16.10	85.0
Do	Nov. 9	16.70	15.36	85.6
J. M. Weiser	...do	17.10	15.73	88.2
Averages		15.00	13.79	83.7

It will be noted that the samples were analyzed in November. Analyses made in September and October showed much lower sugar contents and purity. The general averages for the selected results given in the table—15 per cent of sugar in the juice, or 13.79 per cent in the beets, and 83.7 purity coefficient of the juice—are the best ever secured in the State and compare very favorably with results secured in States where beet-sugar factories are located. If such results could be secured year after year, it is evident that beet-sugar factories could be built and operated with profit in this area. But it would hardly be safe to base general conclusions on the results of a single season. Only by several repetitions of this experiment can the feasibility of establishing the industry in Virginia be demonstrated.

The following are results of the analysis of a remarkable sample of sugar beets submitted by the Hassinger Lumber Company, Konnarock, Va., the analysis being made by James H. Gibboney, chemist:

Gravity	degrees Brix	21.70
Sugar in the juice	per cent	19.33
Sugar in the beets	do	17.80
Purity	coefficient	89.10

WASHINGTON.

Washington has a sugar factory at Waverly. There are a number of places in the State where the building of sugar factories is seriously contemplated. Companies have been organized; in some cases contracts have been made with farmers to grow the beets; considerable capital has been subscribed; concessions have been tentatively secured from towns such as free building sites, remission of taxes for a period of years, and other privileges. All these are simply awaiting developments, or more opportune conditions. Among places under consideration are Thorp, North Yakima, and Spokane.

WYOMING.

There are several well-planned and well-organized schemes for the building of sugar factories in Wyoming. Conditions are quite similar to those of Colorado and Montana. Most places under contemplation will require irrigation to grow sugar beets. The particular places developing the most interest are Worland, Lander, Rawlins, Lovell, Sheridan, and Wheatland.

WHEATLAND.—Joseph M. Carey, of Wheatland, makes the following report:

While the growing of sugar beets in Wheatland has not gone beyond the experimental stages, experiments have gone so far as to leave no doubt whatever that the soil, water, and climatic conditions are such that the sugar beets can be as profitably grown in the colony as in any other part of the United States. The yield per acre has been large, and the beets have been rich in saccharine

matter—as high as 23 per cent. The experts of several factories have made critical examinations of conditions at Wheatland, and their reports have been most favorable for the industry. Last season (1908) premiums were offered by the Wyoming Development Company for the growing of sugar beets. The idea was not to get a larger acreage, but to turn the attention to sugar-beet culture. Without exception, when the beets were given proper attention, splendid results were attained. The crops were large and the quality high. While the colony has not yet secured a sugar factory, we believe the time is short before one will be constructed. Negotiations are going on which may lead to the building of a factory during the present season.

COMPARATIVE MERITS OF CANE AND BEET SUGAR.

Discussion concerning the comparative merits of cane and beet sugar has been going on since the inception of the beet-sugar industry. As California has developed considerable interest in beet-sugar production the agricultural experiment station at Berkeley carried on exhaustive experiments in order to demonstrate the comparative merits of these two sugars. The experiments were under the charge of Prof. G. W. Shaw, the specialist of the agricultural college and experiment station of the State, who has charge of all investigations relating to beet-sugar production. Professor Shaw has had a wide experience in connection with beet-sugar production.

Below I reproduce from a publication of the station [a] the results of his experiments.

CANE SUGAR VS. BEET SUGAR.

The relative merits of sugar from beets and that from cane have been a moot question ever since beet sugar has become such an important factor in the sugar market. The friends of sugar from cane early in the days of the beet-sugar industry maintained that beet sugar was repulsive, ill-flavored, ill-looking, and entirely inferior to cane sugar. As soon as it was found that sugar, white and pure from a technical standpoint, could be made in the beet-sugar factory directly from beets, and that this sugar would analyze as close to 100 per cent as the product from cane, the friends of the latter advanced other arguments, especially to the effect that beet sugar could not be used for various purposes for which the older cane product had long been employed. Even to-day the question is often under discussion. On account of this, and the numerous statements made in public meetings and in the columns of newspapers that beet sugar can not be safely used for purposes of fruit preserving and canning, and the fact that this idea is quite prevalent among housekeepers, cannery men, and confectioners, certain experiments were undertaken in the canning of fruit and the making of jellies, using beet sugar and checking the results against the same kinds of fruits prepared in the same manner with cane sugar.

The sources of the sugar.—The sugar from cane was purchased from the Western Sugar Refinery, San Francisco, Cal., and was guaranteed to be from cane. The sugar tested 99.7 per cent pure sucrose. The beet sugar was made directly from beets grown at Oxnard, Cal., and was manufactured by the

[a] Circular No. 33, August, 1907.

American Beet Sugar Company, the sugar having been donated by that company for the purposes of this test. Analysis showed this sugar to be 99.8 per cent pure sugar, and thus fully equal to the cane product in sugar value. Both of these sugars had been "blued" with ultramarine, after the common practice in sugar manufacture, and thus were not different from the sugar found on the market.

The fruit and the method.—The fruit used in the experiments comprised cherries, apricots, plums, peaches, and pears. Each of these was preserved in different strengths of sirup in the ordinary methods of canning employed in the commercial canneries, as well as after the methods followed in the household practice of canning and jelly making.

In the cannery the method of procedure was to make up a concentrated sugar solution by dissolving 350 pounds of sugar in tanks, then reducing portions of the concentrated solution to the desired density, as shown on a spindle. In the case of apricots, both peeled and unpeeled fruit were put up after the ordinary cannery methods, and in the regular course of work with sirup showing 40 per cent sugar; with green-gage plums 10 per cent sirup was used; with pears, 10, 15, 20, 30, 40, and 55 per cent sirup was used; and with peaches 40 per cent sirup. In most instances all these strengths were used both in the case of sugar from cane and sugar from beets, but in the case of one cannery only beet sugar was used.

In the making of the sirup some difference was noted in the action of different grades of sugar. The beet sugar caused the more froth in the making of sirup, but further investigation led to the conclusion that this was due to the finer granulation of the beet sugar. This was proven by the use of cane sugar of about the same granulation in another batch of sirup, in which case the same frothing occurred as with the beet product. This has been noted in other instances, and canners are wont to count this against the beet sugar, but it is only the result of not comparing sugars of the same granulation. This difference in the action due to the difference of granulation was the only apparent difference arising during the making of the sirup. This is not an essential difference between these sugars, however, as the character of the granulation is entirely dependent upon the wish of the manufacturer, the methods of boiling and granulation being the same in both cases. The sugar ordinarily used by the canners is known as "dry, coarse, granulated"—a grade not commonly made by the beet-sugar manufacturers, because there has not yet been a sufficient demand to warrant its production; but it could be made by them as readily as the ordinary granulation.

The several kinds of fruit were placed in cases in the ordinary manner, and stored in a rather unfavorable location for a period of two years, cans of each variety being opened from time to time to observe the change, if any. Of the 2,000 cans which were thus treated only 6 cans from the beet-sugar lot and 7 from the cane-sugar lot spoiled during the two years, and this spoilage was evidently due to imperfect sealing of the cans, thus showing the utter lack of foundation for the idea that fruits do not keep well when preserved with beet sugar, and that such sugar does not work well in the cannery.

In the household trials both apricots and peaches were canned in a 40 per cent sirup, 50 cans in each lot, the ordinary glass fruit jars being used as containers in each case. From these not a single can spoiled during the two-year period.

In the jelly trials, apples and currants were used as the basis, equal quantities of juice and sugar being used, and the mixture being boiled until of the right consistency to jell. The product in each case was as clear as it is possible

for jelly to be, and not the slightest difficulty was experienced in the making of it.

In connection with this work an attempt was made to trace numerous reports to the effect that fruit had been lost through the use of beet sugar, but in not a single case was it found that the person so losing fruit positively knew that the sugar from the beet had been used. The following is typical of all the answers received to letters of inquiry on the subject:

"I know nothing of the relative merits of beet sugar and cane sugar, and merely stated that I had been told that the one was sweeter than the other, and a lady at the table stated that some years ago she had been given to understand that beet sugar was not good to put up preserves."

Writing concerning this subject, one of the largest and best-known preservers of California fruit says:

"We have used this (beet sugar) very largely in our work for the past four or five years, using it almost exclusively in our fruit department, and we put up as fine goods as can be made. We think that alone speaks well for beet sugar. While it will not cook quite as white as the cane sugar and boils easier, yet with most goods we find it is fully as good as the cane sugar. We do not use any antiseptics whatever in our fruits and have no trouble with the keeping qualities."

The secret of success in canning lies in a perfect sterilizing of the fruit and sirup, and one of the canners in replying to an inquiry as to their use of beet sugar expressed the matter very tersely in the following words:

"While we have not so far used beet sugar, yet we believe we would have no more difficulty in sterilizing beet-sugar sirup than cane-sugar sirup or water."

In the early days of sugar refining there may possibly have been some foundation for an objection of this kind, but it certainly does not exist to-day with the most modern methods of manufacture adopted by the beet-sugar houses. The sugar which is used by the larger canners is made without the ordinary bluing used in other sugars. There are two kinds of bluing which have been used upon sugar, viz, methyl blue and ultramarine blue. The former coloring matter is undoubtedly open to the objection that in contact with certain acids it is either intensified in color or, if the color of the fruit is yellow, it imparts a greenish tinge, both of which undesirable conditions were experienced in the early days of sugar manufacture. Methyl blue, however, is seldom used for this purpose to-day, ultramarine blue being used instead, about 2 pounds of this material being used for 100,000 pounds of sugar.

The utter folly of this idea that beet sugar can not be used for canning purposes is further emphasized by the fact that practically all the sugar used in Germany and France for the purposes of canning and preserving is from the beet, and for many years American refined beet sugar was used without complaint in this country, because the mass of the people were not aware that it was derived from the beet. This sugar was brought here as raw sugar from Europe, refined at American refineries, and consumers purchased it under the false idea that it was cane sugar.

But as the industry began to grow rapidly in the United States attention was directed to the source of sugar, and there has arisen this popular error, which may have been somewhat fostered by interested parties.

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